PREDICTION OF COLLEGE SUCCESS AT MIDDLE TENNESSEE STATE COLLEGE

By

ARLIE ANDREW ADKINS

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CHAPTER I

INTRODUCTION

The Problem

Statement of the problem. The number of students desiring entrance into college had been expected to increase markedly in the years ahead. One could hardly pick up his local newspaper, a periodical, or publication without being made aware of the seriousness of this problem.[1] It was further anticipated that many colleges would have difficulty meeting these new demands.

The expansion of Middle Tennessee State College had been especially rapid over the last few years. Multiple pressures growing out of the need to bring facilities up to community demands and to increase course offerings to care for the larger number of students who would apply had created many problems--some new, some not quite so new, but all characterized by symptoms which could not be dismissed lightly.

There was convincing evidence that the enrollment at Middle Tennessee State College in 1968 (6,000) would be more than double that of 1960 (2,850). These enrollment figures were based on the 1963

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[1] "Six Thousand Due at College by 1968 Term," The Daily [Murfreesboro, Tennessee] News Journal, April 21, 1963.

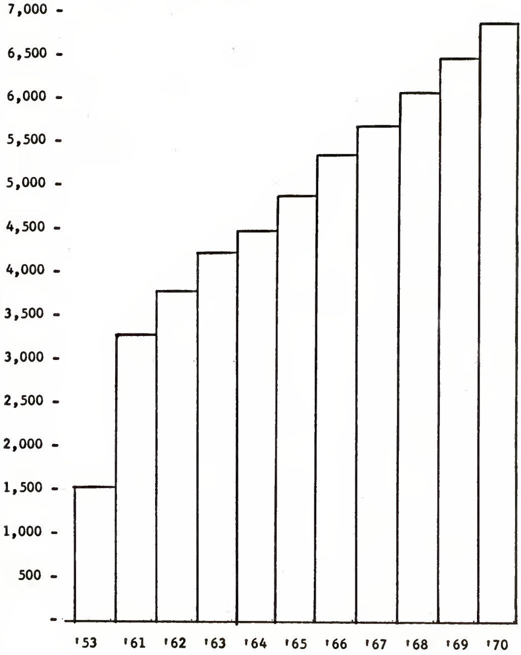

FIGURE 1

PROJECTED ENROLLMENT FOR MIDDLE TENNESSEE STATE COLLEGE FROM 1961 TO 1970. 1953 SHOWN FOR A DECADE COMPARISON WITH 1963 (PRESENT ENROLLMENT). ENROLLMENT FIGURES ARE BASED ON 1963 PROJECTIONS OF THE DEAN OF ADMISSIONS, MIDDLE TENNESSEE STATE COLLEGE.

projection of enrollment by John Weems, Dean of Admissions, at Middle Tennessee State College.

It was anticipated that Middle Tennessee State College would have to be much more selective in its admission policies in the immediate future. The policy of the Tennessee State Board of Education required that all graduates of Tennessee high schools be accepted by Tennessee's state colleges. However, in view of the anticipated heavy enrollments, Middle Tennessee State College in cooperation with the State Board and the other state colleges may be allowed to require the establishment of "persuasive counseling" (directive counseling aimed at discouraging the enrollment of anticipated low ability students), required entrance dates (other than the fall semester), and/or more stringent admission requirements. It was assumed that the College should give first chance to matriculants who, as best as could be determined, would profit most from a college education.

This study was planned to give factual information on how well the available test data and other information obtained routinely from each applicant could be used to forecast his future success in the College. No single study would, of course, solve the selection problem. But it was possible to narrow the field with regard to the efficiency of a group of predictor variables, that is, to discover which were effective in forecasting college success and which were not.

Statement of the specific problem. In this study, the specific attempt was to find the best predictors of college success from a set of eleven variables. A random sample of the entering classes of 1961-62, and 1962-63 at Middle Tennessee State College was used for determining these predictors. The predictor variables consisted of family background, test records, and high school records. The criterion was college success as determined by grade point average.

Need for the study. Studies in college grade prediction and the application of their findings to the problem of college admissions selection had important meaning to all those concerned with the effective utilization of facilities for higher education. The question of who should be admitted to college probably never would find an answer universally acceptable, for possibly there were as many different answers as there were schools of higher education--each with its own educational philosophy and objectives.

The many presumed differences among colleges, and the student populations drawn by them, undoubtedly had been largely responsible for the tremendous number and variety of prediction studies reported. That many of the studies had produced divergent findings was strong evidence that the presumed differences might, in fact, be real. Masten, in commenting on this situation, wrote:

> If this be so then it would seem naive at best, and unreasonable at worst, for any college to attempt to apply "outside" findings to the selection of its own students. What is needed, in the interests of both the college and the student population it serves,

> is local research into the question of what makes for academic success at that particular college.[2]

Fredericksen stated the situation thusly, "My first recommendation [to colleges] therefore, is that local validity studies should be made."[3] Lowry and Spraker stated that:

> While the amount of information concerning success in engineering study is extensive and of considerable value, it is important for at least two reasons that each school of engineering make a study of its own special problems dealing with the selection of its students. First, although there is considerable agreement among the findings of investigators, there are also notable disagreements. This fact indicates that the particular combination of factors most predictive of success in engineering school A is not necessarily the best combination for engineering school B. Engineering schools differ widely in their selection criteria, the quality of their programs, and the populations from which they draw their students. Second, each school must select students for admission and does so on the basis of some set of factors, whether or not these factors have been studied to determine their validity to predict success. Each school has a folder of information about each applicant. The kinds of information in these folders vary with the schools. One question, then, becomes that of how best to use the information available in a particular school.[4]

Thus it seemed clear enough that if effective admissions selection and meaningful counseling were desirable then careful examination of factors related to achievement at that college were mandatory. Therefore, this study was needful because it might help solve an immediate educational and administrative problem; namely, that of efficient selection of entering students. Previously, the College had had no real problem of selection as it could handle all who wished to attend. Moreover, it had been College policy to admit almost all high school graduates who indicated a desire to go to college even when their abilities, as shown by high school records, were questionable. The educational philosophy of most state colleges was to give the poorer student another chance, and this program had been followed at Middle Tennessee State College. Overcrowding presented a new problem which the College hoped to meet by becoming more selective in its student body.

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[2] Sherman H. Masten, "The Value of Entrance Tests and Nine High School Variables in the Selection of Freshmen at Hofstra College: A Study in Differential Prediction " (unpublished Doctoral dissertation, New York University, New York, 1962), p. 6.

[3] Norman O. Fredericksen, "Making Test Scores More Useful for Prediction," _Journal of Educational and Psychological Measurement_, 11: 784, Winter, 1951.

[4] William C. Lowry, and Harold S. Spraker, _Predicting Success in the First Year of Engineering Study_ (Charlottesville, Virginia: Division of Educational Research, University of Virginia, 1959), p. 3.

If the college must adopt more stringent admission measures, it could do so only for good reasons. It must proceed from criteria which were meaningful. Only those who were ready, able, and eager to get the most out of a college education should be considered eligible. This proposed the difficulty of achieving a procedure which, beyond question, would cull the unfit. To accomplish this distasteful task, there should be confidence that the culling instrument was essentially valid.

There was, therefore, a need to examine procedures of determining acceptability. To do so, two aspects of the task were evident:

1. Critical examination of the test instruments heretofore used for placement purposes.

2. Evaluation, in similar terms, of other available gauges.

Two years before this study a policy was adopted by which every high school senior in Tennessee who expected to attend a state college in Tennessee was required, in his senior year, to take the American Testing Battery Program (hereafter referred to as ACT), which included subtests in the following areas: English, mathematics, social studies, and natural sciences. In addition, Middle Tennessee State College required all prospective matriculants to take the Otis Self-Administering Tests of Mental Ability. This battery constituted the official placement testing program of Middle Tennessee State College. Non-Tennessee students, however, were frequently admitted without having taken these tests or any comparable battery of tests. In such cases they were required to take the test battery during the Fall pre-registration orientation program. The latter was true also with regard to transfer students.

Masten pointed out that "the type of problem here investigated seems significant not only because local grade prediction studies are important but because we need to explore further into the values of the high school record for grade prediction."[5]

Angell summed up the advantage of local differential grade prediction studies in this manner:

> For those college educators who are now sensing an increasing need for ways and means of identifying the academic talents of their students, it is quite apparent that differential prediction techniques provide an advanced and systematic method of assessing their potentialities. . . . Certainly, one could reasonably expect

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[5] Masten, _op. cit._, p. 8.

to see real improvement in academic counseling and more realistic programming. One could also reasonably expect to see a reduction in the rate of college student attrition due to academic failure.[6]

Statement of specific purposes. The specific purposes of this study were: (1) to analyze the distributions of scores attained on the test battery (the four subtests of ACT and the Otis Self-Administering Tests of Mental Ability) by matriculants so that it could be determined whether or not this instrument, or any section of it, constituted a dependable or acceptable device for determining the placement or acceptability of the matriculants; (2) to discover, if possible, other instruments (type of home community, status of the applicant's home and family, high school status, and similar measures) for which dependability and acceptability could be shown to be of a higher order than the basic battery then used; (3) to test the feasibility of making such predictions; and (4) to set up regression equations or predictive formulas if it were valid to make such predictions.

Limitations of the study. There were several aspects of the study which served to limit the general applicability of the findings to other schools. Problems of selection by means of tests were always subject to revision in other settings and at other times. Selection methods validated under different circumstances rarely gave the same results. Middle Tennessee State College drew a large section of its student body from approximately a fifty mile radius of Murfreesboro. Moreover, its entrance policy--as was true of many state colleges--had always been liberal. These circumstances limited the generality of the results.

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[6] M. A. Angell, "Multiple Differential Prediction-Significance for College Academic Counseling," *Personnel and Guidance Journal*, 37: 421, February, 1959.

In addition, it was recognized that no method of prediction had been found to be completely reliable. Individuals were just too complex for the clumsy measures that had so far been devised. However, limiting as this was, it was not to say that the idea of prediction was quite hopeless; such a conclusion was far from realistic. Awkward as they were, certain combinations of measures were made to yield rather dependable probability ratios, depending upon what was being predicted.

Delimitations. The delimitations of this study were:

1. It confined itself to those students who entered Middle Tennessee State College as freshmen in the academic years 1961-62 and 1962-63.

2. The findings and conclusions applied specifically to the populations used in this study.

3. While factors other than those selected for study might have value for predicting grades, they were not considered in this study.

4. The populations employed in this study were composed of individuals for whom all of the study variables were in evidence.

Definitions of Terms Used

Situational variables. Situational variables were those used for identification purposes only and included the following:

1. Middle Tennessee State College student number--A.
2. Number of the high school from which the student graduated--B.
3. Age at matriculation--J
4. Sex--K
5. Class--L

Predictor variables. The predictor variables used in this study reflected three general areas:

1. High school variables.
    (a). Size of the high school attended by the student--C.
    (b). High school grade point average attained by the matriculant--D.
2. Family and home background.
    (a). Size of home community--E.
    (b). Father's primary occupation--F.
    (c). Father's highest attained educational level--G.
    (d). Size of the matriculant's family (number of siblings)--H.
3. Entrance test scores, in the form of standard scores:
    (a). ACT--English subtest--M_1.
    (b). ACT--Mathematics subtest--M_2.

(c). ACT--Social Studies subtest--M_3.

(d). ACT--Natural Sciences subtest--M_4.

(e). Otis Self-Administering Tests of Mental Ability--M_6.

Criterion variables. The criterion variables reflected academic success on several levels. In addition, they depicted the quality of the student's experience, in terms of achievement level, and whether the student finally attained upper division status or not.

Grade point average (GPA). Grade point averages had been taken to be the symbolic measures of achievement in school courses. As symbolic measures, they were considered and treated as numbers on a scale, so that they could be handled appropriately by parametrical statistical techniques.

Class. The word class was used in a very special sense in this study: generally, a class was considered to consist of a group of students who would be graduated in a given year; the term was used in this study to denote those students, collectively, who first entered as freshmen the same year. Thus, the members of the Class of 1961 all entered as freshmen in 1961. The reason for this specialized definition was to permit uniformity in the treatment of the data from those who repeated a course, or courses, or were dropouts.

Scope of the Study

Prediction equations developed on an empirical basis should be drawn from as many potentially contributive variables as possible, and established over a sizeable number of cases. The variables chosen and the groups utilized were described as follows:

Criterion variables. There were three grade point averages chosen as criterion variables with the hope that these grades could be predicted from the predictor variables. The variables were: (1) Grade point averages for first year for entire sample for 1961, (2) Grade point averages for first year for entire sample for 1962, and (3) Cumulative two-year grade point averages of all who completed two years of the Class of 1961. In addition, cross-correlations were made between the ACT subtests and the student's college grade point averages in the related subject courses.

Predictor variables. Eleven predictor variables were chosen as potential predictors. These included Size of high school, High school grade point average, Size of home community, Father's primary occupation, Father's educational level, Size of family (siblings), the four subtests of the ACT, and the Otis Self-Administering Tests of Mental Ability.

Groups upon which the study was based. Data were secured from the College Admissions and Counseling records on freshmen of the classes of 1961 and 1962, who had previously been selected by random sampling. The total number of students selected in this manner upon which all data were available was 528.

Two categorical groupings seemed of sufficient importance for special consideration. These were: (1) sex, and (2) class.

Recognizing that significant cultural differences existed between the sexes in vocational opportunities, common interests, curricular requirements, and biological or maturational differences, it seemed natural to treat male and female as separate groups unless it became apparent that no significant differences existed between them for purposes of academic prediction.

The essence of any predictional study was the assurance that applications of the predictive technique needed not to be limited to the sample from which it was derived, but to apply validly to any sample from the same population. It was necessary, therefore, to group the students by class based on the year of entry to their freshman class so that the feasibility of predicting academic success in later years might be established by tests of the significance of differences among classes.

Two quasi-variables--sex and class--were introduced for the purpose of categorizing. This required six divisions which were combined in the designated two ways so as to determine later the need for such grouping.

Framework of the study. The assumptions which underlay a critical appraisal of prediction procedures took into account the potentials of the college as well as those of the student. They were valid with respect to the capacities of the institution, its physical characteristics, and the constrictions which were generally placed upon such institutions. They considered the constituency which the college sought to serve.

Similarly, the hypothesis which this study sought to test was related to all of these aspects. They were integrated into a framework which was also the structure of the institution--its purpose, its form, and its clientele.

Assumptions. The assumptions which underlaid this study included:

1. The administrative procedures of selection and classification had a far-reaching effect on the welfare of the individual and the college; it was imperative that these procedures be implemented at the optimum degree of confidence, especially in view of rapidly increasing enrollments and high mortality of matriculants.

2. The student's performance was inevitably conditioned by such phenomena as parental and home-town influence, mental and physical characteristics, attitudes, and other observable factors.

3. Capacities and aptitudes were gauged quantitatively and qualitatively by means of situational and environmental data and carefully selected tests. From these it was possible to predict future performance with considerable accuracy.

4. While it was recognized that grade point averages were never perfect reflectors of genuine academic achievement, validity of

grades was generally considered to be high enough to warrant their use as criteria of academic success.

5. Each of the sub-samples (male and female, Classes of 1961 and 1962) used in this study was drawn by random selection from what was considered to be a population homogeneous with respect to sex, educational level, race, geographic area, and level of cultural objective.

6. At the college level male and female characteristics became more sharply differentiated, so that groups were divided by sex and given separate treatment in order to take into account their divergent objectives, interests, habits, attitudes and capacities.

Hypothesis. A general hypothesis was tested in this study. Concomitantly with it, a number of minor postulates was examined or tested. In order to apply statistical techniques, the null form of hypothesis was used.

The primary objective of the study was to examine and analyze the Middle Tennessee State College test battery in use and other variables, which were obtained routinely from student records, to see if some combination of variables actually did provide an index of fitness for college work.

HYPOTHESIS: There was no correlation between the separate standard scores attained by the freshmen classes of 1961 and 1962 on the Middle Tennessee State College test battery and any of the other variables and the grade point averages achieved by these individuals during their lower division college careers.

The overall problem with its background, its current orientation, and some of its features was discussed above. A discussion of some of the approaches and procedures which were employed in the development of measures intended to be used for predictive purposes are set forth in the following chapter. Chapter III outlines the procedures, plans, and objectives of this study. Chapter IV presents the analysis of the data and the statistical tests made. The final chapter contains findings and conclusions, and the several recommendations which seem appropriate.

CHAPTER II

REVIEW OF RELATED LITERATURE

Much literature pertinent to the present work was closely examined and the findings are presented in this chapter. The literature lay in four major overlapping areas: (1) differential prediction and regression studies in general, (2) prediction of success based on high school factors, (3) prediction of success based on socio-economic and other nonintellective factors, and (4) results of studies related to use of standardized tests in academic prediction.

Attempts to use correlational methods in the problem of predicting college success went back thirty-five or forty years, with the height of activity probably in the thirties or forties.[1] There had been sufficient studies over a long enough period of time to provide reliable trends.

Studies of prediction of college success were quite numerous. A comprehensive review of tests and other measures devised to predict college achievement would be a monumental task in itself and would require a study many times the size of this proposed dissertation. Therefore, the emphasis herein was placed on summaries and reviews in the literature. Specific studies will be cited as illustrations especially where they are particularly related to the proposed study.

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[1] Charles V. Mann, "A Study of Engineering Education," Bulletin, Society for the Promotion of Engineering Education, 1923, p. 13.

Prediction

Multiple measurement. Although multiple measurement leading to differential prediction was more complex and more demanding of time than prediction with a single variable, it was more effective. Brogden showed that differential predictors substantially increased the selective efficiency of prediction over the use of a single predictor.[2] This contention was supported by Doppelt:

> Users of tests have increasingly accepted the principle that multiple measurement is a more effective aid to evaluation and counseling than a single score. . . .For such measurement to be effective it must necessarily be differential; that is, the abilities measured should be relatively independent.[3]

However, he added this warning:

> Factor analysis alone is not the solution to the problem of obtaining effective differential tests. We must still do correlation studies for the populations in which we are interested before we can be reasonably sure of independence of measurement.[4]

Frederiksen and Melville demonstrated that the usefulness of a test might be improved by discovering subgroups for which it was especially appropriate as a predictor.[5] Dyer supported this contention:

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[2] Hubert E. Brogden, "Increased Efficiency of Selection Resulting from Replacement of a Single Predictor with Several Different Predictors," Journal of Educational and Psychological Measurement, 11: 173-95, Summer, 1951.

[3] Jerome E. Doppelt, "Progress in the Measurement of Mental Abilities," Journal of Educational and Psychological Measurement, 14: 261-64, Summer, 1954.

[4] Ibid.

> The local situation always has features peculiar to itself which cannot be reached by the centrally organized prediction studies that get into the available literature--and even these are pretty scarce, especially at the high school level.[6]

Dyer added that counselors seemed to do more predictional studies as their training and experience were expanded, but lack of training seemed to be responsible for the dearth of data of this nature.

Correlation and regression considerations. Although correlation was frequently used by educators to express relationship, there were times when a regression equation might be more appropriate. Fisher stated:

> The idea of regression is usually introduced in connection with the theory of correlation, but it is in reality a more general and, in some respects, a simpler idea, and the regression coefficients are of interest and scientific importance in many classes of data where the correlation coefficient, if used at all, is an artificial concept of no real utility.[7]

Schmid amplified Fisher's assertion by listing three major advantages in using regression coefficients: (1) they manifested unidirectional relationships; (2) they preserved the units or scales of the variables being measured; and (3) they were not affected by selection, that is, restriction of the independent variable.[8]

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[5] Norman O. Frederiksen and S. Donald Melville, "Differential Predictability in the Use of Test Scores," Journal of Educational and Psychological Measurement, 14: 647-56, Winter, 1954.

[6] Henry S. Dyer, "The Need for Do-It-Yourself Prediction Research in High School Guidance," Personnel and Guidance Journal, 36: 162-67, November, 1957.

[7] R. A. Fisher, Statistical Methods for Research Workers (Edinburgh: Oliver and Boyd, 1928), p. 112.

Cosand, in his review of twenty-three studies of college admissions criteria, concluded that the average coefficient of correlation between high school average and college grade average was about .55.[9] However, the spread of coefficients around this mean was very broad.

Among the more recent significant studies were those in differential prediction by Horst and his associates.[10] They had been engaged in an ambitious program designed not only to forecast college success in general, but also to predict a student's probable success in major academic areas. For several batteries of tests, correlations with the criteria ranged from around .30 to .90 with a median close to .60. These results were attained by using seven tests in combination with age, sex, and high school variables.[11] The coefficient of .63 obtained by Buckton at Brooklyn College[12] and that of .49 by Boyer and Koken,[13] appeared to be within the range of coefficients averaged by Cosand, and Horst.

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[8] John Schmid, Jr., "Regression Coefficients Versus Correlation Coefficients," Journal of Experimental Education, 23: 379-81, June, 1955.

[9] Joseph P. Cosand, Jr., "Admissions Criteria--A Review of the Literature," California Journal of Secondary Education, 28: 12-21, January, 1953.

[10] Paul Horst, Differential Prediction of Academic Success (ONR Contract Nonr-477(08) and PHR Grant M-743(C3). Seattle: University of Washington, May, 1959), p. 11

[11] Ibid.

[12] LaVerne Buckton, "The Prediction of Student Success at Brooklyn College," Brooklyn College Department of Personnel Services Bulletin, 1949.

Hoffman discussed prediction and forecasting as follows:

> To illustrate the futility of striving for absolute perfection in predictive techniques, we may assume, arbitrarily, that the most careful investigator, under the best possible conditions, may be able to appraise future situations so well that nine times out of ten he can describe future environmental conditions in rather accurate detail. Thus, if a person of such perspicacity can be imagined, he could state, with 90 per cent assurance, the kinds of activities people of different types would be pursuing, the nature of things and ideas and conditions in a world not yet evolved. Man is always trying to do this, in one way or another, but seldom does he achieve a high order of success in his forecasting. Our hypothetical probability of .9 is very high, indeed. If most forecasters could achieve consistently a performance probability of .8 or .6, or even .4 in predicting future world events and conditions, they would be doing well. Such forecasters are anything but common, for an intimate knowledge of cyclic phenomena is required to consistently predict the future configuration of the most general conditions. This is true even with regard to the relatively simple dichotomously expressed variables, which avoid the expression of degree or depth and seek only to define trend--up or down, right or left, white or black.
>
> However, when the investigator attempts to proceed from the general to the particular, from societal behavior to individual performance, his power of prediction is of an even lower order. The experienced predictor dares not wander too far in time, nor can he have a high degree of confidence in details of an individual's behavior in the future. He must try to classify the individual's potential according to level and type, and assume that his ultimate performance will probably not be at variance with that classification.[14]

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[13] L. E. Boyer and J. E. Koken, "Admissions Tests as Criteria in Predicting Beginning Academic Success at Northwestern University," _Journal of Educational Research_, 50: 313-15, December, 1957.

[14] Charles A. Hoffman, "A Study in Predicting Academic Success" (unpublished Doctoral dissertation, University of Florida, Gainesville, 1958), pp. 34, 35.

Methods of handling a large number of variables had become a problem in prediction and forecasting. More variables needed to be considered if nonacademic factors were to be included. Due to the computations involved when many variables were considered, the approach of many investigators had been to seek ways of eliminating most of the variables at an early stage in the computation without seriously effecting the results: Laughlin,[15] Quiller,[16] McAdams,[17] Zuckowsky,[18] and Goodman,[19] had considered this problem.

Cronbach described an alternate procedure to the multiple regression analysis. It was called the multiple-screen or multiple-cut off method of selection.[20] Horst described several accretion methods of selection[21] which seemed to be similar to the Wherry-Doolittle Test Selection Method described by Garrett.[22] Horst and MacEwan had developed a technique of eliminating variables one by one which was the reverse process to the accretion method.[23] A study made at the Lackland Air Force Base sought to compare the efficiency of the long used multiple regression prediction approach, and the more recently developed technique based on the so-called "unique patterns" of difference.[24] The study indicated that the latter technique had a greater potential for certain areas of prediction, and it was particularly revealing in the overlapping of differential patterns, but multiple regression analysis lends itself very well to statistical treatment, and was, of course, more widely understood and interpreted. Therefore, multiple regression analysis, with the aid of automatic computing equipment, was used as the primary technique in this study.

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[15] James W. Laughlin, "College First Semester Academic Achievement as Related to Characteristics of a High School Graduating Class" (unpublished Doctoral dissertation, Pennsylvania State University, State College, 1961).

[16] Gordon F. Quiller, "A Study of College Predictors for First Year Students at Colorado State University" (unpublished Doctoral dissertation, Colorado State University, Fort Collins, 1962).

[17] Henry E. McAdams, "The Prediction of General and Differential Achievement in Two Samples of Junior College Students" (unpublished Doctoral dissertation, University of Southern California, Los Angeles, 1961).

[18] Leo M. Zuckowsky, "The Efficiency of SCAT and Other Selected Variables in Predicting Success in the Various Lower Division College Curricula" (unpublished Doctoral dissertation, University of Notre Dame, South Bend, Indiana, 1961).

[19] Charles H. Goodman, "The MacQuarrie Test for Mechanical Ability: Selecting Radio Assembly Operators," Journal of Applied Psychology, 30: 586-95, December, 1946.

[20] Lee J. Cronbach, Essentials of Psychological Testing (New York: Harper and Brothers, 1949), pp. 268 ff.

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[21] Horst, loc. cit.

[22] Henry E. Garrett, Statistics in Psychology and Education (fifth edition; New York: Longmans, Green and Company, 1958), pp. 426-40.

[23] Paul Horst and Charlotte MacEwan, Predictor Elimination Techniques for Determining Multiple Prediction Batteries (ONR Contract Nonr-477(08). Seattle: University of Washington Division of Counseling and Testing Services, September, 1957).

[24] Joseph A. Tucker, Jr., Relative Predictive Efficiency of Multiple Regression and Unique Pattern Technique (Research Bulletin 53-2. Lackland Air Force Base, Texas: U. S. Air Force Human Resources Research Center, 1953).

Predictive Success of High School Factors

High school grades. Pierson indicated that in surveys of over 200 studies made between 1929 and 1949, the results showed that high school grades usually proved to be the best indicator of college grades.[25] His conclusion was based on surveys of the literature by Durflinger in 1943[26] and Harley F. Garrett in 1948,[27] among others. In his own study, Pierson found that high school grades were more effective than any other factor or combination of factors he used.[28] "It would seem that colleges could do well to place a continued if not an increased emphasis upon the high school grade records"[29] was his major recommendation. Dressel found a statistically measurable and significant relationship between high school performance and college grades. He concluded that high school grades alone constituted fairly good predictors of college grades, the correlation was better than .70 in certain categories.[30] Other studies by Sanders, Osborne and Greene,[31] Henderson and Masten[32] and by Holland[33] substantiated this finding. Chauncey and Frederiksen pointed out that the success of the high school record in predicting college achievement was to be expected due to the similarity of the two situations.[34] Crawford and Burnham concluded that high school standing and American Council on Education Psychological Examination scores were equally effective in predicting first and second year honor point ratios at Yale (each .50 correlation),[35] Bertrand agreed with these findings at Texas A and M College,[36] Kern's findings also supported high school achievement as the best predictor,[37] Laughlin found the high school average to be superior for prediction of first semester college grade point average at Pennsylvania State University.[38] Other investigators who had also concluded that high school grade point average was the best predictor of college grade point average included Long,[39] Steige,[40] McAdams,[41] Quiller,[42] and Zuckowsky.[43]

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[25] Leroy R. Pierson, "High School Teacher Prediction of College Success," Personnel and Guidance Journal, 37: 142-45, October, 1958.

[26] Glenn W. Durflinger, "Prediction of College Success--A Summary of Recent Findings," American Association of Collegiate Registrars, 19: 68-78, October, 1943.

[27] Harley F. Garrett, "A Review and Interpretation of Investigations of Factors Related to Scholastic Success in Colleges of Arts and Science and Teachers Colleges," Journal of Experimental Psychology, 18: 91-138, December, 1948.

[28] Pierson, loc. cit.

[29] Ibid.

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[30] Paul L. Dressel, "Effect of the High School on College Grades," Journal of Educational Psychology, 30: 612-17, November, 1939.

[31] Wilma B. Sanders, R. T. Osborne, and James E. Greene, "Intelligence and Academic Performance of College Students of Urban, Rural, and Mixed Backgrounds," Journal of Educational Research, 49: 185-93, November, 1955.

[32] Harold R. Henderson and Sherman H. Masten, "Six Predictors of College Achievement," Journal of Genetic Psychology, 94: 143-46, March, 1959.

[33] John L. Holland, "Prediction of Scholastic Success for a High Aptitude Sample," School and Society, 86: 290-93, June 21, 1958.

[34] Henry Chauncey and Norman Frederiksen, "The Functions of Measurement in Educational Placement," Educational Measurement (E. F. Lindquist, editor, Washington: American Council on Education, 1951). pp. 85-116.

[35] A. B. Crawford and P. S. Burnham, Forecasting College Achievement (New Haven: Yale University Press, 1946).

[36] John R. Bertrand, "Relationships Between High School Average Grades and Academic Achievement of Agricultural Students at the A and M College of Texas," College and University, 30: 166, January, 1955.

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[37] Bryon L. Kerns, "A Study of Under-Achieving and Over-Achieving First-Semester College Freshmen as Revealed by the Way in Which They View the College Situation and Themselves as College Students" (unpublished Doctoral dissertation, University of Illinois, Urbana, Illinois, 1957).

[38] James W. Laughlin, "College First Semester Academic Achievement as Related to Characteristics of a High School Graduating Class" (unpublished Doctoral dissertation, Pennsylvania State University, State College, 1961).

[39] John M. Long, "The Prediction of College Success from a Battery of Tests and from High School Achievement" (unpublished Doctoral dissertation, The University of Virginia, Charlottesville, 1960).

[40] Robert Steige, "A Differential Study of the Prognostic Value of Admission and Placement Criteria at the University of Colorado" (unpublished Doctoral dissertation, University of Colorado, Boulder, 1962).

[41] Henry E. McAdams, "The Prediction of General and Differential Achievement in Two Samples of Junior College Students" (unpublished Doctoral dissertation, University of Southern California, Los Angeles, 1961).

[42] Gordon F. Quiller, "A Study of College Predictors for First Year Students at Colorado State University" (unpublished Doctoral dissertation, Colorado State University, Fort Collins, 1962).

[43] Leo M. Zuckowsky, "The Efficiency of SCAT and Other Selected Variables in Predicting Success in the Various Lower Division College Curricula" (unpublished Doctoral dissertation, University of Notre Dame, South Bend, Indiana, 1961).

Prediction of college success from high school grades, however, was far from universal. Boyer and Koken produced data which ranked certain scholastic aptitude tests above high school average in ability to forecast college performance.[44] Boyd's results relegated high school standing to second place behind the Ohio Psychological Examination.[45]

Size of high school. The disparity in research findings was not limited to studies of the value of high school grade point average as a predictor of college success. Size of high school also had been studied. Here, too, the results appeared to disagree. Boyd concluded, from his study at Northwestern, that size of high school did not prove a useful prognosticator of college achievement.[46] Laughlin's results led him to the conclusion that class size as a predictor of college grade point average at Pennsylvania State University was of little or no significance.[47] Bledsoe, however, produced evidence that students from large high schools tended to earn significantly higher first-year college grade point averages than did students from small schools.[48] Fritz and Kentner at Iowa[49] agreed with Boyd while Lins' results[50] were in line with Bledsoe's findings.

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[44] L. E. Boyer and J. E. Koken, "Admissions Tests as Criteria in Predicting Beginning Academic Success at Northwestern University," Journal of Educational Research, 50: 313-15, December, 1957.

[45] J. D. Boyd, "The Relative Prognostic Value of Selected Criteria in Predicting Beginning Academic Success at Northwestern University" (unpublished Doctoral dissertation, Northwestern University, Evanston, Illinois, 1955).

[46] Ibid.

[47] Laughlin, loc. cit.

Socio-Economic and Other Nonintellective Factors

Socio-economic factors. Jones reported a low positive correlation between educational level and community status of parents and college grade point average. He found that the lower 10 per cent of the population in the variable of socio-economic status were above the mean of the group in the criterion of college grade point average.[51] He also suggested the use of other family background variables. Quiller concluded that nonintellective variables had value for predicting academic success and would be useful for admission counseling.[52] Stucky and Anderson, in relation to prediction of college success, assumed that not the least of the selective factors operating was that of socio-economic status and background.[53] Mock determined that the only nonintellective community variable of significance was that of median educational level of all adults over twenty-five of county of student's residence.[54] Miller reported that there were many, varied, and yet statistically significant differences in certain factors operating independently of intelligence, and that these must be taken into consideration in the selection of college freshmen.[55] He further added that intellective ability was not the final criterion by which potential college material was to be evaluated. Lunn concluded that social class identification, proportion of teachers with Master of Arts, educational level of principal, occupation of parents, and educational level of parents did not affect scholastic aptitude.[56]

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[48] Joseph C. Bledsoe, "An Analysis of the Relationship of Size of High School to Marks Received by Graduates in the First Year of College," _Journal of Educational Sociology_, 27: 414-18, May, 1954.

[49] M. F. Fritz and V. Kentner, "Scholastic Probation and Size of High School," _Proctor-Iowa Academy of Science_, 53: 610-14, 1956.

[50] Leo J. Lins, "Pre-University Background and the Effect of Various Factors Upon University Success," _Personnel and Guidance Journal_, 33: 157-58, November, 1954.

[51] Wyatt M. Jones, "A Study of Selected Variables Related to College Success" (unpublished Doctoral dissertation, University of Alabama, Tuscaloosa, 1961).

[52] Quiller, _loc. cit._

In a study designed to discover relationships that existed between information available on prospective students and their academic success during their first semester at the University of Oklahoma,

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[53] M. O. Stucky and K. E. Anderson, Study of Persistence in College Attendance in Relation to Placement-Test Scores and Grade-Point Averages (Lawrence: University of Kansas, 1959).

[54] William L. Mock, "Selected Personality, Intellective and Community Characteristics as Related to Academic Success of University of Georgia Students" (unpublished Doctoral dissertation, University of Georgia, Athens, 1961).

[55] James F. Miller, Sr., "A Comparison of Overachievers and Underachievers at The University of Georgia" (unpublished Doctoral dissertation, University of Georgia, Athens, 1958).

[56] Mervel S. Lunn, "The Prediction of Success of Students Enrolled in Professional Education Courses at The University of Oklahoma" (unpublished Doctoral dissertation, University of Oklahoma, Norman, 1961).

Staton determined that more students go to college from parental backgrounds with high level occupation than from backgrounds of low level occupation. However, parent's occupation did not affect success in college.[57] He recommended that questionable students be allowed to enroll in summer school as a trial period before refusing to admit them. Sterrett, used a number of nonintellective variables and found that unsuccessful college students resided in a farm or rural location; their fathers were employed as owner or manager of a farm, skilled tradesman, or factory worker; mother was not employed; parents had high school education or less; income was primarily from wages; farm income was described as less than comfortable; and their families were indifferent about their attending college and entering a professional occupation.[58] Husa concluded that socio-economic factors were not as effective for prediction of college academic success as were high school grade point average and scholastic aptitude tests.[59] Hunt investigated, among other variables occupational level of father, size of family, educational level of parents, and size of home town residence and concluded that none of these were too significant.[60] A number of studies indicated that socio-economic factors were of little significance, however, there seemed to be enough evidence that these factors did influence selection to some degree and would bear further investigation.

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[57] Jon Tom Staton, "The Relationship of Selected Factors to Academic Success for Beginning Freshmen" (unpublished Doctoral dissertation, University of Oklahoma, Norman, 1962).

[58] Marvin D. Sterrett, "Continuation and Withdrawal in a Select Group of Arkansas College Freshmen" (unpublished Doctoral dissertation, George Peabody Colleges for Teachers, Nashville, Tennessee, 1960).

[59] Harold E. Husa, "An Analysis of Various Characteristics Related to the Subsequent Success of Students Readmitted to Northern Illinois University Following Academic Dismissal" (unpublished Doctoral dissertation, Michigan State University, East Lansing, 1961).

Sex. The sex factor was another variable which had been variously studied in the efforts to strengthen the prediction of collegiate grade point achievement. Here, too, the findings were not in complete agreement. Early studies by Fricken,[61] and Rundquist[62] agreed upon the finding that the coefficient of correlation between college grades and high school average was higher generally for girls than for boys, and that girls' college achievement was more predictable than boys'.

Grater found that the quantitative score on the American Council on Education Psychological Examination correlated with college grade point average about .23 for males but .68 for females. Linguistic scores, however, correlated with college average about the same for the sexes.[63] Abelson concluded from his study of six coeducational colleges that ". . . it may be more useful in predictive studies to consider boys and girls as belonging to different populations and to analyze their data separately rather than lumped together,"[64] Hoffman's study also essentially confirmed these findings.[65]

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[60] James G. Hunt, "A Study of Nonintellectual Factors Related to Academic Achievement Among College Seniors at Ball State Teachers College" (unpublished Doctoral dissertation, Purdue University, Lafayette, Indiana, 1961).

[61] C. E. Fricken, "Predicting Achievement in the Liberal Arts College," School and Society, 42: 518-20, October, 1935.

[62] Edward A. Rundquist, "Sex, Intelligence and School Marks," School and Society, 103: 452-56, April, 1941.

However, Bergeron's findings seemed to indicate the reverse. He found that the sex factor did not contribute significantly to the prediction equation.[66] Jex, while recognizing sex differences in grade prediction, said, "From a practical standpoint such a breakdown hardly seems worthwhile."[67] Many investigators regarded the high school grade factor as the best single predictor of college grades for both sexes, though more efficient for women than for men. Certainly the sex factor needed study to determine how it might influence the predictor variables in different educational settings.

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[63] Harry Grater, "A Statistical Analysis between ACE Scores and Grade-Point Averages," Journal of Educational Research, 49: 307-10, December, 1955.

[64] Robert P. Abelson, "Sex Differences in Predictability of College Grades," Journal of Educational and Psychological Measurement, 12: 642-43, Winter, 1952.

[65] Charles A. Hoffman, "A Study in Predicting Academic Success" (unpublished Doctoral dissertation, University of Florida, Gainesville, 1958).

[66] W. L. Bergeron, "An Analysis of the Relationship between Selected Characteristics and Academic Success at the University of Arkansas" (unpublished Doctoral dissertation, University of Arkansas, Fayetteville, 1953).

[67] F. Jex, University of Utah Studies in the Prediction of Academic Success (Research Monographs in Education, Salt Lake City: University of Utah, 1957), p. 31.

Non-scholastic tests and ratings. In searching for better prediction efficiency a number of investigators had studied the influence of other nonintellectual factors upon college point grade averages. Some of these had produced positive findings. Fredericksen and Melville found that the predictive ability of entrance tests was greater for engineering students classified as "compulsive" than for those not so classified.[68] Frick found that the Minnesota Multiphasic Personality Inventory raised the coefficient of multiple correlation sixteen points when added to a combination of ability test scores and high school averages.[69] MacLachlan and Burnett concluded that "willingness to discuss problems" significantly differentiated potentially superior students from those not potentially superior.[70] Kim found that personality tests contributed significantly to grade prediction.[71]

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[68] Norman O. Fredericksen and S. D. Melville, "Differential Predictability in the Use of Test Scores," Journal of Educational and Psychological Measurement, 14: 647-56, Winter, 1954.

[69] J. W. Frick, "Improving the Prediction of Academic Achievement by Use of the MMPI," Journal of Applied Psychology, 39: 49-52, January, 1955.

[70] Patricia S. MacLachlan and C. Burnett, "Who Are the Superior Freshmen in College?" Personnel and Guidance Journal, 32: 345-49, February, 1954.

[71] Ki Suk Kim, "The Use of Certain Measurements of Academic Aptitude, Study Habits, Motivation, and Personality in the Prediction of Academic Achievement" (unpublished Doctoral dissertation, Louisana State University, Baton Rouge, 1957).

There were also studies which disallowed the importance of personality tests in grade point average prediction. Rishel's research made use of such tests as the Edwards Personal Preference Schedule, Allport-Vernon-Lindsey Study Values, Strong Vocational Interest Blank for Men, Kuder Preference Record (Form CH), Minnesota Teacher Attitude Inventory, Cottle Experimental Scale on Attitudes, and the Educational Interest Inventory and determined that none of these was valid for selection of students.[72] Lunn used the Sims Social Class Identification Occupational Rating Scale and the Minnesota Teacher Attitude Inventory in his study of University of Oklahoma students but concluded that they were not useful as prognostic tools.[73] Jensen reached the same conclusion, employing the Taylor Anxiety Scale at the University of Nebraska Teachers College.[74]

Studies of the value of standardized personality tests as grade predictors had been paralleled by studies of less formal, though perhaps more readily available, personality "ratings" in the form of the evaluations prepared by the high school for its college-bound graduates.

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[72] Darrell F. Rishel, "The Development and Validation of Instruments and Techniques for the Selective Admission of Applicants for Graduate Studies in Counselor Education" (unpublished Doctoral dissertation, Pennsylvania State University, State College, 1961).

[73] Mervel S. Lunn, "The Prediction of Success of Students Enrolled in Professional Education Courses at The University of Oklahoma" (unpublished Doctoral dissertation, University of Oklahoma, Norman, 1961).

[74] William R. Jensen, "Anxiety, n-Achievement, Aptitude, and Prior Knowledge as Predictors of College Achievement" (unpublished Doctoral dissertation, University of Nebraska Teachers College, Lincoln, 1961).

Masten determined that for female students with education majors the factor of High School Personality Rating had the highest correlation (.492) of all eleven admissions variables used in his study.[75] The factor of High School Recommendation also appeared in his regression equation as a predictor.[76] Gardner found that personality ratings could be used as prognostic tools, but should be used with scholastic predictors.[77] Farwell in using the high school principals' recommendations of the applicants, stated, "This investigation . . . repudiates the logic of placing unquestionable faith in recommendations from high schools."[78] Mock's research also disavowed personality ratings as dependable selection predictors.[79] Pierson concluded that high school teachers' predictions of college success by rating personality traits were not consistently high enough to be of any value in regression equations.[80] Once again it seemed clear that there was much diversity in the research findings.

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[75] Sherman H. Masten, "The Value of Entrance Tests and Nine High School Variables in the Selection of Freshmen at Hofstra College: A Study in Differential Prediction" (unpublished Doctoral dissertation, New York University, New York, 1962).

[76] Ibid.

[77] Marion E. Gardner, "Prediction of Academic Success in College from Personality Trait Ratings Obtained for High School Graduates" (unpublished Doctoral dissertation, University of Pittsburgh, Pittsburgh, 1958).

[78] Gail F. Farwell, "A Coordinated Program of Admissions and Counseling," Personnel and Guidance Journal, 35: 239, December, 1956.

[79] William L. Mock, "Selected Personality, Intellective, and Community Characteristics as Related to Academic Success of University of Georgia Students" (unpublished Doctoral dissertation, University of Georgia, Athens, 1961).

Standardized Achievement and Aptitude Tests

A number of different types of tests of academic achievement and ability had also been devised to predict college success. Many of these tests were measures of general scholastic aptitude, and those that were carefully constructed had met with consistently good results. Correlation coefficients obtained had ranged from 0 to as high as .70 with a median somewhere near .45.[81]

Significant for this study was the comment of Chauncey and Fredericksen regarding the limitations of academic aptitude and achievement tests. They pointed out that those working in the field felt that the maximum correlation coefficient that could be attained was about .70 to .75.[82] They went on to say that nonacademic factors such as motivation, interest, study methods, persistence, and personal adjustment would probably enter into any significant advancement in predicting college success.[83] Wolking found that both the Differential Aptitude Test and the Primary Mental Ability Tests were significantly useful in predicting academic achievement. The Primary Mental Ability Test battery indicated a correlation value as high as .70 for the relationship between grades and the general intelligence factor.[84]

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[80] Leroy R. Pierson, "High School Teacher Prediction of College Success," Personnel and Guidance Journal, 37: 142-45, October, 1958.

[81] Henry Chauncey and Norman Fredericksen, "The Functions of Measurement in Educational Placement," Educational Measurement (E. F. Lindquist, editor, Washington: American Council on Education, 1951). pp. 85-116.

[82] *Ibid.*

The American College Testing Program reported a range of correlation coefficients' values from a low of .38 to a high of .78 for the relationship between grades for all colleges participating in the program and the composite score of the ACT battery.[85] Staton investigated the relationship of selected factors to academic success and concluded that the ACT battery was of little significance in predicting college grade point average; although, it was more successful in the case of females than for males.[86] Smith also studied the predictive value of the ACT battery and determined that it was much more effective as a prognostic instrument for Arkansas high schools of 400 or more students than for high schools with less than 400 students.[87] The effectiveness of the ACT battery for college selection purposes had also been investigated by Peters and Piog,[88] and Tiedeman.[89]

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[83] Ibid.

[84] William D. Wolking, "Predicting Academic Achievement with the Differential Aptitude and the Primary Mental Abilities Tests," Journal of Applied Psychology, 39: 115-18, April, 1955.

[85] D. P. Hoyt and E. F. Lindquist, "Summary Data for All Colleges" (mimeographed, ACT Research Service, The American College Testing Program, Iowa City, 1962).

[86] Jon Tom Staton, "The Relationship of Selected Factors to Academic Success for Beginning Freshmen" (unpublished Doctoral dissertation, University of Oklahoma, Norman, 1962).

The Otis Quick-Scoring Mental Ability Test was used by Wellman with the Primary Mental Abilities Tests to predict grades. He predicted average grades and grades in English, mathematics, and science at the high school level. Wellman found that the tests could be used successfully for prediction, and that the Otis contributed most when used alone.[90] Similar conclusions were reached by Jones[91] and Ridley[92] who were also using the Otis Quick-Scoring Mental Ability Test.

Scores on specific tests of the Iowa Tests of Educational Development had been found to correlate highly with marks in related subjects, and they might be used as measures of aptitude for those areas.[93] Ebel and Hill provided a general review of the literature dealing with the use of achievement tests in the prediction of academic success.[94]

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[87] Fay W. Smith, "An Analysis of the Relationship of Size of Arkansas High School and the Achievement of College-Bound Seniors" (unpublished Doctoral dissertation, University of Arkansas, Fayetteville, 1961).

[88] F. R. Peters and E. L. Piog, "Effectiveness of the ACT for Selection and Placement at the Ohio State University," Educational Research Bulletin, 40: 232-41, December, 1961.

[89] David V. Tiedeman, "The American College Testing Program Examination," Personnel and Guidance Journal, 41: 814-19, May, 1963.

[90] F. E. Wellman, "Differential Prediction of High School Achievement Using Single Score and Multiple Factor Tests of Mental Maturity," Personnel and Guidance Journal, 35: 512-17, April, 1957.

[91] Wyatt M. Jones, "A Study of Selected Variables Related to College Success" (unpublished Doctoral dissertation, University of Alabama, Tuscaloosa, 1961).

[92] W. N. Ridley, "The Prognostic Value of Freshman Tests Used at Virginia State College" (unpublished Doctoral dissertation, University of Virginia, Charlottesville, 1954).

The tests and scales discussed herein constituted only a few of the many instruments designed to aid in predicting academic performance. The literature included interest and personality tests, intelligence tests, perception and psychological tests, reasoning tests, dexterity and coordination tests, tests of spatial visualization, aptitude tests, speed tests, verbal comprehension tests, analogies and vocabulary tests, scales and appraisals to differentiate individuals with regard to sex or age or background, and a myriad of instruments to measure achievement in a given area and to relate it to some hereditary or environmental factor. Any or all or some combination of these might aid in the prediction of future success. Some of them furnished only vague clues; others provided an assessment or capacity or potential of a large number of talents. Among these are to be found the proper instruments of prediction. As Hoffman remarked:

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[93] Science Research Associates, Inc., "How to Use the Test Results: A Manual for Teachers and Counselors," The Iowa Tests of Educational Development (fifth revision, Chicago: Science Research Associates, Inc., 1957). p. 55.

[94] Robert L. Ebel and Robert E. Hill, Jr., "Development and Applications of Tests of Educational Achievement; Prediction of Academic Success," Review of Educational Research, 29: 49-56, February, 1959.

> Such tools may take any form--previous school record, community background, I.Q., a specialized and standardized examination score--in fact, any condition or device by means of which an individual may be gauged. Success in prediction depends upon the successful isolation of some gauge or combination of gauges.[95]

Masten stated:

> It seems clear that there is more diversity in the research findings than many summations of the literature might suggest. The question of what causes this diversity probably has its answers largely in differences in the nature of the populations studied, the academic settings against which they are studied and the particular grading systems and standards governing the populations studied.[96]

These differences had been recognized by most of the researches heretofore mentioned. Many of the researchers cited, as a rationale for their studies, the preeminent need for localized data. Knag concluded from his study, "Much of the literature offers little help to the local college in its own problems of predicting grades."[97]

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[95] Charles A. Hoffman, "A Study in Predicting Academic Success" (unpublished Doctoral dissertation, University of Florida, Gainesville, 1958). p. 42.

[96] Sherman H. Masten, "The Value of Entrance Tests and Nine High School Variables in the Selection of Freshmen at Hofstra College: A Study in Differential Prediction" (unpublished Doctoral dissertation, New York University, New York, 1962).

[97] H. A. Knag, "A Study of the Predictive Value of the Admission Procedures of Queens College for the Year 1950-51" (unpublished Doctoral dissertation, Teachers College, Columbia University, New York, 1953). p. 5.

CHAPTER III

DEVELOPMENT OF THE STUDY

A combination of measures which together constituted a dependable instrument in predicting academic success for applicants to Middle Tennessee State College could not be found merely by tossing all kinds of differentiated data into a box and then withdrawing a certain number and labelling them "Prediction Battery."

Rather, it was necessary at the beginning to try to determine just what factors, for a particular group of Middle Tennessee State College students, had contributed to the differentiation of these matriculants with regard to success or failure. As a result, the freshmen classes of 1961 and 1962 were selected to be examined in as much detail as possible for their various peculiarities.

The procedures used in this study were primarily selective, collective, and computational in nature. The selective phase consisted of delimiting the scope of the study and resulted in the determination of the variables to be used. The collective phase included the obtaining of the original data from the admissions records of the students selected for the study, and the recording of these data in a form suitable for machine interpretation. The computational phase involved the application of machine operations to the assembled data.

Selection of the Sample

Only two freshmen classes have entered Middle Tennessee State College since the test battery (ACT and the Otis Self-Administering Tests of Mental Ability) became mandatory. Previous to 1961 the test battery was administered on a voluntary basis with only about 50 per cent of the freshmen participating. Therefore, the freshmen classes entering in 1961 and 1962 were selected for study.

In preparation of the samples a table of random numbers was used, and in order to be certain that the desired sample sizes would ultimately be obtained extra cases were included. This was a fortunate precaution since it later developed that a number of cases were dropped for various reasons.

Lists of all students were secured from the Admissions Office. In 1961 the original male sample consisted of 175, and of this number 21 withdrew before completing their first semester and 11 were discarded for lack of data, with the result that complete distributions of the data for 143 men were obtained. The original female sample consisted of 113. The number of females in the final sample was 99, 11 withdrew during the first semester and 3 had incomplete data. The final samples for the second year of these groups were 68 for the men and 61 for the women.

Of the male samples for 1962 there were 18 cases discarded, 1 for lack of data and 17 for withdrawal, with a result of 160 male cases used in the sample. Only 4 cases had to be discarded in the female sample for the Class of 1962, with a resultant total of 126 used in the study. In all four groups there was a total of 528 usable cases. The sample data are projected in Table 1.

The total study group consisted of 303 males (58 per cent) and 225 females (42 per cent). The total original entering classes consisted of 63 per cent males and 37 per cent females. The difference in the per cents was primarily caused by the greater persistence of the women.

The Data

When the variables were determined, it was a simple but tedious task to record the data from the cumulative records. Obtaining the data required locating, identifying, recording, sorting, and counting the scores.

Data collection. For each of the 528 cases included in the study, 21 items were obtained. It can be seen from Table 2 that 5 items were included primarily for identification purposes. The last 4 items were included so that cross-correlations could be made between the student's score on each of the ACT subtests with his grade point average in the related subject matter field. These correlations could be used for counseling purposes as an indication of a student's probable success in major academic areas. Fortunately, most of the test data, in usable form, were in the student's cumulative folder in the College Registrar's Office. Cumulative records are kept securely locked in the vaults of the College. Permission was obtained from

TABLE 1

RANDOM SAMPLE DISTRIBUTION OF FRESHMEN GROUPS

	1961		1962		1961 & 1962
	Male	Female	Male	Female	Total
Original Sample Drawn	175	113	178	130	596
Number Completing One Semester or More	143	99	160	126	528
Number Withdrawn First Year	21	11	17	3	52
Incomplete Data (Discarded)	11	3	1	1	16
Number Withdrawn Two Years	96	38	- -	- -	
Number Completing Two Years	68	61	- -	- -	

TABLE 2

ITEM-CODE FOR TABULATIONS OF SAMPLE DATA

Item	Description
	Situational
A	Student identification number, Middle Tennessee State College
B	Number of high school from which student graduated
J	Age at matriculation
K	Sex
L	Class
	Predictor
C	Size of high school from which student graduated, 1-6
D	High school grade point average, coded 4-0
E	Size of home community, coded 1-8
F	Father's primary occupation, coded 1-9
G	Father's educational level, coded 1-7
H	Size of family (number of siblings), coded 1-9
M_1	ACT English subtest, standard score
M_2	ACT Mathematics subtest, standard score
M_3	ACT Social Studies subtest, standard score
M_4	ACT Natural Sciences subtest, standard score
M_6	Otis Self-Administering Tests of Mental Ability

TABLE 2--Continued

Item	Description
	Criteria
X_1	College grade point average for first year for entire sample for 1961
X_2	College grade point average for first year for entire sample for 1962
Y	Cumulative two-year grade point average of all who completed two years of the Class of 1961
	Subject Grade Point Averages
1	College grade point average for English courses for first year for entire sample for 1961
2	College grade point average for mathematic courses for first year for entire sample for 1961
3	College grade point average for social studies courses for first year for entire sample for 1961
4	College grade point average for natural science courses for first year for entire sample for 1961

the President of Middle Tennessee State College, Dr. Quill Cope, to extract the necessary information at the mutual convenience of the Dean of Admissions and the writer.

Some of the data had to be revised or converted in order to be included in this study. An account of these is given below.

1. High school grade point average. It is difficult to find a common ground for the comparison of high school transcripts from a large number of different schools. However, in this study, the problem was simplified by the fact that a large majority of the students came from a relatively small number of high schools.

Numerical averages were not determined the same way in all schools; consequently they were not considered a good basis for comparison. Class standing might have been used when adjusted for differences in the sizes of the graduating classes, except that many schools did not give this information.

It was found that the only data more or less generally available were the grades given on the transcripts, either in the letter system of grading ("A", "B", "C", "D", "F"), or in a system easily convertible to the letter system.

Inasmuch as the criteria of the study were the college grade point averages of the students in the freshman year, and for some in the sophomore year, it seemed that the best way to handle the high school data was to compute for each student a high school grade point average. This was done in the following way:

(a). Since grades were usually given for each one-half unit in the Carnegie System, the second-half unit was used as the basic unit for the computation of the high school grade point average.

(b). The transcript of each student was reviewed and the number of "A" grades for each unit of credit was determined. Also, the numbers of "B", "C", "D", and "F" grades, respectively, were determined. Fractional units were computed on a proportional basis.

(c). Following the system used at the College, 4 grade points were given for each "A", 3 points for each "B", 2 points for each "C", 1 point for each "D", and no grade point was given for an "F" grade.

(d). The high school grade point average was then computed by taking the total number of grade points and dividing this sum by the total number of units of credit.

(e). Discrepancies were dealt with in the following manner:

(1). Physical education in high school was not counted in the high school grade point average, nor was band or chorus.

(2). All grades were not recorded in the letter system. Some schools used the per cent system. All numerical per cent grades were converted to the letter system, using the conversion system of the specific school involved in each case.

(3). Several students had incomplete high school programs. They were primarily veterans and others who were admitted to the College by means of a satisfactory score on the General Educational

Development Test. When the transcript was incomplete, the case was discarded.

2. The nonintellective factors were coded as follows:

   (a). Size of high school, coded 1-9

   (b). Size of home community, coded 1-8

   (c). Father's primary occupation, coded 1-9

   (d). Father's educational level, coded 1-7

3. The American College Testing Program. In the compilation of these data, standard scores were used. However, since the standard scores were standardized separately for male and female they were not comparable for the two sexes.

4. Otis Self-Administering Tests of Mental Ability. In the compilation of these data, raw scores were used.

5. College grade point average. Since the college grade point averages were the criteria of the study, all students who did not have at least some college grades from which to determine a college grade point average were eliminated.

The computation of the college grade point average was as follows:

(a). The basic unit used in the computation of the college grade point average was the credit hour.

(b). For each student, the number of "A" credit hours was determined. Also, the number of "B" credit hours, "C" credit hours, "D" credit hours, and "F" credit hours attempted was determined.

(c). Four grade points were given for each "A" credit hour, 3 for each "B" credit hour, 2 for each "C" credit hour, and 1 for each "D" credit hour. No grade points were given for "F" grades.

(d). The college grade point average was then computed by dividing the total number of grade points by the total number of credit hours attempted.

(e). When the grade of "I" (incomplete) was recorded for a student, it was checked to determine, if possible, the final disposition of the grade. If no final determination of the grade could be found, the policy of the College in dealing with incomplete grades was followed. If the period of grace (one semester) had expired, the grade was taken as "F". If the period of grace had not expired, the grade was not counted.

Identification and sorting of the records. Although the anonymity of each set of pupil data had to be guaranteed, the student number assigned by the College was used so that, if it should become necessary, the writer could relocate a record and check the accuracy of its transcription. The student number consisted of six numerals and was punched along with the codes for sex, school, age, and class into the identification field of the data cards.

Identification of sex was made by using the digit "1" to represent male and the digit "2" to represent female. Classes were identified with the digit "1" representing the Class of 1961 and the digit "2" representing the Class of 1962.

The data were recorded first on sheets of quarter-inch grid paper. Next, they were punched into IBM cards in the format described in Table 3. This resulted in a total of 528 cards, one for each student. These cards were run through a sorting machine two times: first, to separate the male from female and, secondly to group them by class.

Treatment of Data

With all the original data punched on cards, the next step was to obtain the needed statistics through the use of a computer.

The support of the Computing Center of the University of Florida was secured for the use of an International Business Machine 7090 Computer. The program used was an IBM Fortran 7090 Program Number ERMPR 3 as modified by Rev Wright, Code name L-041 and 041-A. The program is generally known as the Stepwise Multiple Regression Program BSL-070.[1]

The computational routine of the program first transformed the raw input data and then performed a stepwise multiple regression upon the transformed data. The transformed data consisted of m sets containing n independent variables and one dependent variable. A weighting factor w_1 was associated with each set of observations. A subset of regression coefficients for K variables ($K = n$) was then obtained which were significant at a given specified level of significance.

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[1] "Stepwise Multiple Regression Program-BSL-070, Code L-041" (Gainesville, Florida: Computing Center of the University of Florida, undated). (Mimeographed.)

TABLE 3

IDENTIFYING NUMBERS OF THE VARIABLES WITH THEIR SEQUENTIAL COLUMNAR ARRANGEMENTS IN FIELDS ON IBM CARDS

Variable	Name of Variable	Start In Column	End In Column
A	Student number	3	8
B	Number of high school	9	11
C	Size of high school	12	12
D	High school grade point average	13	15
E	Size of home community	16	16
F	Father's primary occupation	17	17
G	Father's educational level	18	18
H	Size of family (siblings)	19	19
J	Age at matriculation	20	20
K	Sex	21	21
L	Class	22	22
M_1	ACT English subtest	23	24
M_2	ACT Mathematics subtest	25	26
M_3	ACT Social Studies subtest	27	28
M_4	ACT Natural Sciences subtest	29	30
M_6	Otis Self-Administering Tests of Mental Ability	33	34
X_2	College grade point average, 1962	43	45
X_1	College grade point average, 1961	49	51
Y	College grade point average, two-year cumulative, 1961	58	60

Therefore, in this study, instructions were incorporated into the program to read variables only at the .01 level of significance. Then, a number of intermediate regression equations were obtained, adding one variable at a time. The variable added was that one which made the greatest improvement in "goodness of fit." A weighting factor was assigned to each set of data. Certain sets of data had higher reliability than others, and weighting factors were applied in relation to their reliabilities. In the final regression only the significant variables were included. A variable which was approximately a linear combination of other independent variables was not entered into the regression. This eliminated the possibility of degeneracy and permitted single precision floating point operations.

After the raw input data had been transformed, the next step was the calculation of weighted sums of squares and cross-products. The following values were calculated:

1. Weighted number of data = $\sum W_t$
2. Weighted sums of variables = $\sum W_t X_{i \cdot t}$
3. Weighted sums of squares and cross products = $\sum W_t X_{i \cdot t} X_{j \cdot t}$

   Where:

   $t = 1$ to m

   $i = 1$ to $n + 1$

   $j = i$ to $n + 1$

   Note:

   $X_{n+1} = y$

The weighted means, residual sums of squares, and the residual sums of cross products were calculated next. These were calculated as follows:

1. Mean $= \bar{X}_i = \sum W_t X_{i \cdot t} / \sum W_t$
2. Residual sums of squares and cross products $=$

$$\frac{\sum W_t \sum W_t X_{i \cdot t} X_{j \cdot t} - \sum W_t X_{i \cdot t} \sum W_t X_{j \cdot t}}{\sum W_t}$$

Where:

$t = 1$ to m

$i = 1$ to $n + 1$

$j = i$ to $n + 1$

$y = X_{n + 1}$

In the two preceding steps the upper triangular part of a symmetrical square matrix was calculated. The entire r_{ij} (simple correlation coefficients) symmetrical square matrix was obtained as follows:

1. Residual sum of squares $= x_i \; x_i$
2. Residual sums of cross products $= x_i \; x_j$

   Calculated:

$\sigma i = \sqrt{x_i \; x_i}$

$r_{ij} = \frac{x_i \; x_j}{\sigma i \; \sigma j} =$ simple r

$rji = r_{ij}$

$r_{ii} = 1.000$

Where:

$$i = 1 \text{ to } n + 1$$

$$j = i + 1 \text{ to } n + 1$$

Next, the stepwise calculation of regression coefficients and reliability gave the following intermediate equations:

1. $Y = B_o + B_1X_1$
2. $Y = B_o + B_1X_1 + B_2X_2$, etc.

The coefficients for each of these intermediate equations and the reliability of each coefficient were obtained by the stepwise procedure. The obtained values and reliability varied with each subsequent equation. The coefficients represented the best values when the equation was fitted by the specific variables included in the equation. The variable was added that gave the greatest reduction in variance of the dependent variable.

If a variable was indicated to be significant at an early stage, it entered the regression equation. With the addition of several other variables to the regression equation, an insignificant variable was sometimes indicated. Under this situation the stepwise regression procedure removed the insignificant variable before adding an additional variable. Thus, at the various steps in the regression procedure, only those variables which were significant were included in the regression equation.

The last phase in the stepwise procedure was the calculation of predicted values for the dependent variable and the deviations between actual and predicted values.

The raw data for the independent variables were entered into the machine computation without regard to the placement of the decimal point. The only variable affected by this was variable "D" (High school grade point average) with the result that in predicting a college grade point average when "D" was one of the predictors the decimal had to be moved two places to the right.

The correlation matrices involving the ACT subtests and the respective college subject grade point averages were computed with the aid of a desk calculator using the Pearson Product-Moment Correlation Method.

$$r = \frac{N\Sigma XY - \Sigma X \cdot \Sigma Y}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2][N\Sigma Y^2 - (\Sigma Y)^2]}}$$

The evaluation of "t"

$$t = \frac{M_1 - M_2}{\sigma d_m}$$

Where σd_m = (Standard error of a difference between uncorrelated means)

was employed as the statistical technique for testing whether both the dropouts (those who dropped out before receiving any grade point credits) and those students who remained in the College represent a single homogeneous population. The evaluation of "t" was determined for each of the intellectual predictor variables of each group used in the study.

A total of six regression equations was obtained. The calculation of these equations concluded the computational work required of the electronic data-processing machines. The quantitative findings and directions for their application are furnished in Chapter 4; more general conclusions are presented in Chapter 5.

CHAPTER IV

ANALYSIS OF THE DATA

Introduction

This study was undertaken to evolve sets of equations that could be used to predict college grade point averages by sex for the first year and the second year at Middle Tennessee State College. Each of the six regression equations obtained utilized three of the eleven independent variables with the exception of one, which utilized only two.

In order to understand the results, it is necessary first to know the character of the eleven independent variables included in the study. These variables have been described previously in a general way. In the list that follows, the eleven predictor variables and the criteria are specifically described. The predictor variables are labeled C, D, E, F, G, H, M_1, M_2, M_3, M_4, and M_6. The criteria are labeled X and Y.

Predictor variables:

Variable C. The size of high school attended by the student and tabulated at 9 levels:

1. 1 - 149
2. 150 - 299
3. 300 - 449
4. 450 - 599
5. 600 - 749

6. 750 - 899
7. 900 - 1,049
8. 1,050 - 1,199
9. 1,200 and above

Variable D. A high school grade point average which was computed specifically for this study. The grade point averages were weighted from 4 to 0:

A - - - 4
B - - - 3
C - - - 2
D - - - 1
F - - - 0

Variable E. The size of the student's home community was tabulated as follows:

1. 1 - 2,499
2. 2,500 - 4,999
3. 5,000 - 9,999
4. 10,000 - 24,999
5. 25,000 - 49,999
6. 50,000 - 99,999
7. 100,000 - 199,999
8. 200,000 and above

Variable F. The father's primary occupation, as reported by the students, was tabulated at 9 levels:

1. Laborer
2. Semi-skilled
3. Skilled
4. Clerical
5. Supervisory
6. Small businessman
7. Farmer
8. Executive
9. Professional

Variable G. An attempt to give some idea of the formal educational status of the students' father at time of matriculation was tabulated at 7 levels:

1. No formal schooling
2. Elementary school
3. High school
4. Business college
5. Junior college
6. College or university
7. Graduate or professional school

Since items F and G were reported by the students the possibility of error was not overlooked. It was assumed, however, that these students were capable of giving a fairly accurate response, and that the responses were, in general, honest. Sanders, Osborne, and Greene, in a recent study,[1] checked the latter element of honesty in student response and found the level to be quite accurate.

Variable H.	The number of siblings in the family.
Variable M_1.	The standard score made on the ACT English subtest.
Variable M_2.	The standard score made on the ACT Mathematics subtest.
Variable M_3.	The standard score made on the ACT Social Studies subtest.
Variable M_4.	The standard score made on the ACT Natural Sciences subtest.
Variable M_6.	The raw score made on the Otis Self-Administering Tests of Mental Ability.

Criteria or dependent variables:

Variable X_1. The college grade point average earned during the freshman year by each student in the entire sample of 1961.

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[1] Wilma B. Sanders, R. T. Osborne and James E. Greene, "Intelligence and Academic Performance of College Students of Urban, Rural, and Mixed Backgrounds," *Journal of Educational Research*, 49: 185-93, November, 1955.

Variable X_2. The college grade point average earned during the freshman year by each student in the entire sample of 1962.

Variable Y. The two-year cumulative grade point average of all students of the Class of 1961 who completed two years.

Middle Tennessee State College weighs grade points from 4 to 0:

A - - - 4
B - - - 3
C - - - 2
D - - - 1
F - - - 0

Thus, a student who earned a C in a 2-hour course would be credited with 4 grade points. If he had earned an A in a 3-hour course, his grade points for that course would be 12. His grade point average for both courses considered together would be the sum of these grade points, 16, divided by the total number of course hours, 5, or 3.20.

The findings of the study fell into three major sections: (1) the correlation matrices, (2) the analyses of multiple correlation which provided the predictive equations, and (3) the significance of differences between the means.

The Correlation Matrices

The Fortran program for obtaining the correlation matrices was described in Chapter III. The number of cases, the mean, and the standard deviation of each variable were computed by this program for each group homogeneous in class and sex. The results are summarized in Tables 4 - 11. All calculations in the accompanying tables were

TABLE 4

NUMBER OF CASES, MEAN, AND STANDARD DEVIATION FOR EACH VARIABLE FIRST-YEAR 1961 MALE

Variable	Name of Variable	Number of Cases	Mean	Standard Deviation
C	High school size	143	5.490	2.48
D	High school grade point average	143	2.350	.67
E	Size of home community	143	3.678	2.44
F	Father's primary occupation	143	4.364	2.18
G	Father's educational level	143	3.140	1.90
H	Number of siblings	143	2.958	1.55
M_1	ACT English subtest	143	15.462	4.65
M_2	ACT Mathematics subtest	143	16.720	5.88
M_3	ACT Social Studies subtest	143	16.965	5.87
M_4	ACT Natural Sciences subtest	143	17.497	7.02
M_6	Otis Self-Administering Tests of Mental Ability	143	49.622	9.79
X_1	College grade point average	143	1.757	.88

TABLE 5

NUMBER OF CASES, MEAN, AND STANDARD DEVIATION FOR EACH VARIABLE FIRST-YEAR 1961 FEMALE

Variable	Name of Variable	Number of Cases	Mean	Standard Deviation
C	High school size	99	5.455	2.65
D	High school grade point average	99	3.003	.62
E	Size of home community	99	3.808	2.47
F	Father's primary occupation	99	5.040	2.24
G	Father's educational level	99	3.343	1.52
H	Number of siblings	99	2.717	1.74
M_1	ACT English subtest	99	18.737	4.72
M_2	ACT Mathematics subtest	99	15.192	6.49
M_3	ACT Social Studies subtest	99	17.697	5.48
M_4	ACT Natural Sciences subtest	99	16.697	5.64
M_6	Otis Self-Administering Tests of Mental Ability	99	51.283	9.46
X_1	College grade point average	99	2.363	.68

TABLE 6

NUMBER OF CASES, MEAN, AND STANDARD DEVIATION FOR EACH VARIABLE CUMULATIVE TWO-YEAR 1961 MALE

Variable	Name of Variable	Number of Cases	Mean	Standard Deviation
C	High school size	68	5.191	2.53
D	High school grade point average	68	2.668	.64
E	Size of home community	68	3.809	2.48
F	Father's primary occupation	68	4.500	2.26
G	Father's educational level	68	3.059	1.33
H	Number of siblings	68	2.882	1.68
M_1	ACT English subtest	68	17.132	4.72
M_2	ACT Mathematics subtest	68	18.382	6.48
M_3	ACT Social Studies subtest	68	18.206	5.68
M_4	ACT Natural Sciences subtest	68	19.162	7.71
M_6	Otis Self-Administering Tests of Mental Ability	68	51.647	10.50
Y_1	College grade point average	68	2.260	.42

TABLE 7

NUMBER OF CASES, MEAN, AND STANDARD DEVIATION FOR EACH VARIABLE CUMULATIVE TWO-YEAR 1961 FEMALE

Variable	Name of Variable	Number of Cases	Mean	Standard Deviation
C	High school size	61	5.082	6.76
D	High school grade point average	61	3.131	.42
E	Size of home community	61	3.771	2.47
F	Father's primary occupation	61	5.082	2.34
G	Father's educational level	61	3.361	1.55
H	Number of siblings	61	2.525	1.67
M_1	ACT English subtest	61	19.689	3.97
M_2	ACT Mathematics subtest	61	15.508	6.54
M_3	ACT Social Studies subtest	61	18.475	5.14
M_4	ACT Natural Sciences subtest	61	17.049	5.57
M_6	Otis Self-Administering Tests of Mental Ability	61	52.623	8.28
Y_1	College grade point average	61	2.557	.44

TABLE 8

NUMBER OF CASES, MEAN, AND STANDARD DEVIATION FOR EACH VARIABLE FIRST-YEAR 1962 MALE

Variable	Name of Variable	Number of Cases	Mean	Standard Deviation
C	High school size	160	5.381	2.47
D	High school grade point average	160	2.235	.36
E	Size of home community	160	3.775	2.53
F	Father's primary occupation	160	4.731	2.28
G	Father's educational level	160	3.381	1.61
H	Number of siblings	160	3.169	1.81
M_1	ACT English subtest	160	16.100	5.05
M_2	ACT Mathematics subtest	160	16.906	5.98
M_3	ACT Social Studies subtest	160	16.550	5.40
M_4	ACT Natural Sciences subtest	160	17.431	6.04
M_6	Otis Self-Administering Tests of Mental Ability	160	46.963	10.91
X_2	College grade point average	160	1.570	.64

TABLE 9

NUMBER OF CASES, MEAN, AND STANDARD DEVIATION FOR EACH VARIABLE FIRST-YEAR 1962 FEMALE

Variable	Name of Variable	Number of Cases	Mean	Standard Deviation
C	High school size	126	5.762	2.78
D	High school grade point average	126	2.912	.58
E	Size of home community	126	3.683	2.31
F	Father's primary occupation	126	5.032	2.36
G	Father's educational level	126	3.778	1.75
H	Number of siblings	126	2.929	1.61
M_1	ACT English subtest	126	19.508	4.40
M_2	ACT Mathematics subtest	126	16.746	11.10
M_3	ACT Social Studies subtest	126	17.944	6.24
M_4	ACT Natural Sciences subtest	126	18.238	10.60
M_6	Otis Self-Administering Tests of Mental Ability	126	48.960	11.10
X_2	College grade point average	126	2.320	.79

TABLE 10

COMPARISON OF MEAN AND STANDARD DEVIATION FOR EACH VARIABLE WITH 1961 GROUPS FOR BOTH YEARS

Variable	1961 FIRST YEAR				1961 TWO-YEAR CUMULATIVE			
	Male		Female		Male		Female	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
C	5.490	2.48	5.455	2.65	5.191	2.53	5.082	6.76
D	2.350	.67	3.003	.62	2.668	.64	3.131	.42
E	3.678	2.44	3.808	2.47	3.809	2.48	3.771	2.47
F	4.364	2.18	5.040	2.24	4.500	2.26	5.082	2.34
G	3.140	1.90	3.343	1.52	3.059	1.33	3.361	1.55
H	2.958	1.55	2.717	1.74	2.882	1.68	2.525	1.67
M_1	15.462	4.65	18.737	4.72	17.132	4.72	19.689	3.97
M_2	16.720	5.88	15.192	6.49	18.382	6.48	15.508	6.54
M_3	16.965	5.87	17.697	5.48	18.206	5.68	18.475	5.14
M_4	17.497	7.02	16.697	5.64	19.162	7.71	17.049	5.57
M_6	49.622	9.79	51.283	9.46	51.647	10.50	52.623	8.28
X	1.757	.88	2.363	.68	2.260	.42	2.557	.44

TABLE 11

COMPARISON OF MEAN AND STANDARD DEVIATION FOR EACH VARIABLE WITH EACH GROUP OF FIRST-YEAR STUDENTS

Variable	1961				1962			
	Male		Female		Male		Female	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
C	5.490	2.48	5.455	2.65	5.381	2.47	5.762	2.78
D	2.350	.67	3.003	.62	2.235	.36	2.912	.58
E	3.678	2.44	3.808	2.47	3.775	2.53	3.683	2.31
F	4.364	2.18	5.040	2.24	4.731	2.28	5.032	2.36
G	3.140	1.90	3.343	1.52	3.381	1.61	3.778	1.75
H	2.958	1.55	2.717	1.74	3.169	1.81	2.929	1.61
M_1	15.462	4.65	18.737	4.72	16.100	5.05	19.508	4.40
M_2	16.720	5.88	15.192	6.49	16.906	5.98	16.746	11.10
M_3	16.965	5.87	17.697	5.48	16.550	5.40	17.944	6.24
M_4	17.497	7.02	16.697	5.64	17.431	6.04	18.238	10.60
M_6	49.622	9.79	51.283	9.46	46.963	10.91	48.960	11.10
X	1.757	.88	2.363	.68	1.570	.64	2.320	.79

carried to 4 decimals, but were rounded to conserve space. These statistics were obtained primarily for descriptions of the groups and for use in determining regression equations. It should be made clear, however, that it was unwise to infer causality from correlation, and such usuage should not be attempted without careful study of all possible influences--many of which lie well beyond the bounds of this study.

The r matrix. Although the total number of basic measures consisted of twenty-two independent sources of data for each of the 528 students included in the subsamples, not all of these were variables. Five of these were simple identifiers--necessary for sequence in the study and placement in the college records, as well as for furnishing a geographical clue by identifying high schools by number. Beyond the function of providing supplementary sources of information, however, these five measures have not been further analyzed.

The remaining number of measures, all of which had truly variable quality, were processed statistically. All of the several statistical measures have been ascertained and were recorded in an earlier chapter. Their measures of dispersion were compared and contrasted, and from them certain inferences were projected. Table 12 gives the matrix of product-moment correlations for the twelve variables used in the primary aspect of this study. The first row contains the correlations of each of the predictor variables with the criterion, X_1 male (Grade point average for first-year for entire sample for 1961).

TABLE 12

PRODUCT-MOMENT CORRELATIONS FOR TWELVE VARIABLES FOR FIRST-YEAR 1961 MALE

	C	D	E	F	G	H	M_1	M_2	M_3	M_4	M_6
X_1	-.01	.53	-.03	.07	.04	-.04	.43	.39	.42	.41	.36
C		-.30	.38	.03	.26	.02	.05	.08	.16	.08	.10
D			-.35	.16	-.01	-.07	.35	.44	.27	.34	.24
E				-.06	.21	.05	.05	-.08	.11	-.05	.02
F					.38	.08	.07	.15	.10	.00	.06
G						.01	.13	.04	.22	.05	.14
H							-.14	-.10	-.09	-.09	-.21
M_1								.42	.51	.50	.56
M_2									.43	.44	.54
M_3										.56	.55
M_4											.57
M_6											

The remainder of the matrix gives the product-moment correlations among the predictor variables. A correlation of .16 or more for an N of 143 was significant at the .05 level and a correlation of .21 or more was significant at the .01 level. Garrett's table of levels of significance was used to determine significance.[2] Tables 13 - 17 presented the matrix of product-moment correlations respectively for each of the five remaining criteria variables and also the product-moment correlations among the predictor variables. In Table 13 a correlation of .20 or more for an N of 99 was significant at the .05 level and a correlation of .26 or more was significant at the .01 level.[3] In Table 14 a correlation of .24 or more for an N of 68 was significant at the .05 level and a correlation of .31 or more was significant at the .01 level.[4] In Table 15 a correlation of .25 or more for an N of 61 was significant at the .05 level and a correlation of .33 or more was significant at the .01 level.[5] In Table 16 a correlation of .15 or more for an N of 160 was significant at the .05 level and a correlation of .20 or more was significant at the .01 level.[6] In Table 17 a correlation of .17 or

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[2] Henry E. Garrett, Statistics in Psychology and Education (fifth edition; New York: Longmans, Green and Company, 1958), p. 201.

[3] Ibid.

[4] Ibid.

[5] Ibid.

[6] Ibid.

TABLE 13

PRODUCT-MOMENT CORRELATIONS FOR TWELVE VARIABLES FOR FIRST-YEAR 1961 FEMALE

	C	D	E	F	G	H	M_1	M_2	M_3	M_4	M_6
X_1	-.05	.66	-.08	-.06	-.12	-.03	.65	.48	.57	.38	.50
C		-.18	.38	.22	.20	-.10	-.14	-.05	-.10	-.19	.02
D			-.46	-.20	-.23	.02	.49	.29	.37	.26	.34
E				.06	.14	-.26	.01	.18	.06	.05	.14
F					.56	.19	-.07	-.12	-.01	-.09	-.07
G						.01	.03	-.02	.07	.01	.07
H							-.06	.01	.00	-.05	-.09
M_1								.45	.63	.55	.61
M_2									.49	.50	.58
M_3										.69	.66
M_4											.64
M_6											

TABLE 14

PRODUCT-MOMENT CORRELATIONS FOR TWELVE VARIABLES FOR TWO-YEAR CUMULATIVE 1961 MALE

	C	D	E	F	G	H	M_1	M_2	M_3	M_4	M_6
Y	.02	.49	-.04	.10	.29	-.30	.36	.34	.43	.26	.33
C		-.23	.43	-.04	.22	.08	.12	.11	.08	.17	.02
D			-.46	.25	.12	-.08	.33	.50	.29	.28	.33
E				-.11	.21	-.03	-.03	-.09	.09	-.08	-.09
F					.43	.16	.03	.15	.11	-.04	.03
G						-.07	.21	.13	.22	.04	.19
H							-.18	-.25	-.18	-.16	-.40
M_1								.40	.54	.52	.60
M_2									.44	.40	.63
M_3										.57	.61
M_4											.57
M_6											

TABLE 15

PRODUCT-MOMENT CORRELATIONS FOR TWELVE VARIABLES FOR TWO-YEAR CUMULATIVE 1961 FEMALE

	C	D	E	F	G	H	M_1	M_2	M_3	M_4	M_6
Y	-.16	.51	-.05	-.06	-.11	.04	.43	.55	.47	.40	.50
C		-.25	.35	.29	.23	-.15	-.11	-.16	-.10	-.28	.08
D			-.45	-.38	-.32	.06	.33	.31	.22	.22	.28
E				.37	.14	-.31	.04	.07	.04	-.01	.06
F					.52	.23	-.07	-.17	.00	-.01	-.05
G						-.02	.05	-.01	.18	.04	.08
H							.04	.04	.06	.10	.01
M_1								.38	.49	.49	.47
M_2									.32	.48	.48
M_3										.72	.57
M_4											.60
M_6											

TABLE 16

PRODUCT-MOMENT CORRELATIONS FOR TWELVE VARIABLES FOR FIRST-YEAR 1962 MALE

	C	D	E	F	G	H	M_1	M_2	M_3	M_4	M_6
X_2	-.07	.43	-.07	.15	.07	.03	.23	.26	.21	.30	.21
C		-.30	.36	-.03	.15	-.12	.04	.15	.11	.15	.18
D			-.40	.08	-.13	-.02	.25	.33	.26	.21	.19
E				.03	.22	-.06	-.05	-.07	-.02	-.02	.12
F					.42	.02	.24	.28	.08	.23	.17
G						-.28	.14	.10	.00	.06	.09
H							-.10	-.06	-.11	-.04	-.11
M_1								.53	.51	.59	.60
M_2									.50	.55	.62
M_3										.68	.62
M_4											.60
M_6											

TABLE 17

PRODUCT-MOMENT CORRELATIONS FOR TWELVE VARIABLES FOR FIRST-YEAR 1962 FEMALE

	C	D	E	F	G	H	M_1	M_2	M_3	M_4	M_6
X_2	.03	.61	.11	.08	.11	.08	.46	-.13	.16	-.07	.55
C		-.30	.43	.19	.16	-.14	.09	.23	.34	.19	.07
D			-.25	-.07	-.08	.06	.46	.11	.27	.16	.41
E				-.03	.02	-.11	.00	.06	.17	.03	.11
F					.50	.08	.04	.05	.09	.04	.06
G						.09	.15	-.05	.02	-.04	.12
H							.06	-.17	-.09	-.11	.06
M_1								.05	.29	.07	.70
M_2									.75	.86	-.11
M_3										.85	.15
M_4											-.06
M_6											

more for an N of 126 was significant at the .05 level and a correlation of .22 or more was significant at the .01 level.[7]

It was noted that the attainment of a specific level of significance made no guarantee whatever that merely because the derived value of r exceeded at a given level the values shown in Tables 12 - 17 that there then must be causal relationship. Assurance was indicated, however, in these cases, that the r value was too large to be the result of a sampling accident.

The supplementary r matrix. Of special interest in this study was the examination, for counseling purposes, of the cross correlations between the ACT subtests and the grade point averages achieved in each of the respective subject fields. The standard errors and the coefficients of correlation for males were shown in Table 18.

The ACT composite was shown to correlate higher with all of the subject matter grade point averages than did any of the subtests with the exception of the Social Studies subtest correlation of .367 with the social studies grade point average. However, when the standard error was considered there was no significant difference between these two.

There seemed to be no one best ACT subtest for use with guiding students into prospective majors. Both the Social Studies and the Natural Sciences tests served better than either the English or the Mathematics subtests. The Natural Sciences subtest had a higher correlation (.478) with the English grade point average, and the Social

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[7] *Ibid.*

TABLE 18

PRODUCT-MOMENT CORRELATIONS FOR ACT AND SUBTESTS WITH GRADE POINT AVERAGES IN MAJOR SUBJECT FIELDS - 1961 MALE

Grade Point Average		ACT English M_1	ACT Mathematics M_2	ACT Social Studies M_3	ACT Natural Sciences M_4	ACT Composite M_5
English	r	.581	.448	.387	.478	.593
	SE	.056	.067	.072	.065	.055
	N	.142	.142	142	142	142
Mathematics	r	.207*	.214*	.323	.315	.328
	SE	.095	.095	.090	.090	.083
	N	101	101	101	101	101
Social Studies	r	.230*	.226*	.367	.251	.339
	SE	.088	.089	.081	.087	.075
	N	115	115	115	115	115
Natural Sciences	r	.326	.392	.350	.340	.426
	SE	.075	.071	.074	.075	.069
	N	141	141	141	141	141
Total	r	.431	.390	.421	.411	.468
	SE	.068	.071	.069	.070	.066
	N	143	143	143	143	143

*Significant at .05 level only; all others significant at .01 level.

Studies subtest had a higher correlation (.367) with the social studies grade point average. Perhaps the Social Studies subtest could be considered of best use because of the rather low correlation (.251) between the Natural Sciences subtest and social studies grade point average as this correlation was just barely significant at the 1 per cent level of confidence.

The English grade point average was the most easily predicted, ranging from .387 with the ACT Mathematics subtest to .581 with the ACT English subtest or .593 with the ACT composite score. These last actually represented the highest coefficients of correlation obtained for the males. It was expected that the ACT subtests would correlate higher with their respective subject matter grade point averages than with other subject matter. This was true for English .581, and social studies .367, but not true for the natural sciences .340, and for mathematics .214, which was the lowest.

In regard to the female coefficients of correlation, reported in Table 19, it will be noted that only one coefficient fell below the 1 per cent level of significance; that was ACT Natural Sciences subtest with the mathematics grade point average (.175) which was significant at the 10 per cent level.

With the coefficients of correlation for females as the case was with males, if one subtest were used it would be the ACT Social Studies test which ranged from .438 to .567. The ACT composite correlations, again, were slightly higher than those of the Social Studies subtest.

TABLE 19

PRODUCT-MOMENT CORRELATIONS FOR ACT AND SUBTESTS WITH GRADE POINT AVERAGES IN MAJOR SUBJECT FIELDS - 1961 FEMALE

Grade Point Average		ACT English M_1	ACT Mathematics M_2	ACT Social Studies M_3	ACT Natural Sciences M_4	ACT Composite M_5
English	r	.655	.278	.438	.362	.502
	SE	.059	.096	.084	.090	.078
	N	93	93	93	93	93
Mathematics	r	.479	.493	.520	.175*	.518
	SE	.098	.096	.093	.123	.093
	N	62	62	62	62	62
Social Studies	r	.403	.388	.566	.473	.545
	SE	.102	.104	.083	.094	.086
	N	67	67	67	67	67
Natural Sciences	r	.468	.360	.448	.344	.465
	SE	.082	.093	.084	.094	.082
	N	88	88	88	88	88
Total	r	.649	.481	.567	.380	.507
	SE	.058	.077	.068	.086	.074
	N	99	99	99	99	99

*Significant at .10 level; all others significant at .01 level.

The correlation of the ACT English subtest with the English grade point average was .655 which was considerably higher than any other correlation in this series. The ACT Mathematics subtest coefficient of correlation with the mathematics grade point average was .493. The correlation of social studies grade point average with the ACT Social Studies subtest was .566. The lowest correlation of subject matter grade point average with an ACT subtest was that of ACT Natural Sciences (.344) with natural sciences grade point average.

On the whole correlations for the females were higher than those for the males as might be expected since the literature seemed to indicate that grades of females were more easily predicted than those of males.

Analysis of R

Since there were six dependent variables involved in the study separate predictive equations had to be computed for each, this required a total of six such equations. These were derived by (1) selecting the best predictors by the computer program described in Chapter III, and (2) determining the constants of regression and the partial regression coefficients.

The coefficient of multiple correlation, F level for entering variables, standard error of the dependent variable, constant, partial regression coefficient, and standard error of the partial coefficient were tabulated in Appendix A according to each criterion group.

Partial regression coefficients. The partial regression coefficients were used to predict the numerical equivalents of marks in the criterion or dependent variable. The formula

$$Y = B_o + B_1X_1 + B_2X_2 + . . . + B_NX_N$$

was used to predict the most likely score in the criterion variable Y, where B_1 represented the partial regression coefficient of the first independent or predictor variable and X_1 represented its mark or score, B_2 represented the partial regression coefficient of the second independent variable and X_2 represents its mark or score, and so forth through n predictor variables. The constant in the regression equation was denoted by B_o.

The standard error of estimate. The standard error of estimate was used to provide the range within which the predicted grade would fall with a given degree of confidence. For example, if a student got a predicted grade equivalent of 2.50, and he was a member of the male class of 1961 during the first year, one could state that the odds are two to one that such a student would get a grade-value of 2.50 ± .6078--the predicted grade-value minus or plus the standard error of estimate .6078, which was given in Table 22. This established a range between 1.89 and 3.11 within which the students' grade point average was expected to fall, with two chances in three of being correct. In so rounding these numbers such a student would probably receive a grade of C or better (based on Middle Tennessee State College's grade point weight referred to earlier in this chapter). If the distance to the limits was taken as twice the standard error of estimate, the odds were about nineteen to one that the student's grade point average would lie between 1.29 and 3.71, which was the upper limit. Referring to Middle Tennessee State College's grade point weight this student would have about one chance in twenty of getting a grade of D or F.

The coefficient of multiple correlation. The coefficient of multiple correlation served as a validity coefficient, demonstrating the degree of relationship between the predicted variable and the criteria variables taken collectively. Its standard error was used as the standard error of estimate was used--to obtain the range within which one would expect the coefficient of multiple correlation to fall within a given degree of confidence.

The multiple regression equation. The best prediction (R = .805) of college grade point average was obtained by using the multiple regression equation for all eleven predictor variables for the group composed of females in the Class of 1961, as shown below:

$$Y = B_o + B_1X_1 + B_2X_2 + \ldots + B_{11}X_{11}$$

However, it would not be administratively feasible to use this equation in practical prediction problems. The arithmetic involved would far exceed the precision obtained. An illustration of how a multiple correlation close to .805 can be obtained by using only a fraction of the total number of variables follows. For the group referred to above, $Y = B_o + B_1X_D + B_2M_1 + B_3M_2 =$ .775 which, although containing only three variables, is rather close to the total R of .805. This illustrates how multiple correlations close to .805 can be obtained with far fewer than the total number of variables.

According to the Stepwise Multiple Regression Program that variable displaying the highest zero-order coefficient of correlation with the criterion was entered into the equation first. The ordering of subsequent variables depended simultaneously upon the intercorrelations of all predictors and of the predictors with the criterion. Thus, the selection of successive predictors was significantly influenced by selections already made.

In the group cited above the strongest zero-order coefficient of correlation (Table 13) with the criterion was High school grade point average (D) ($r = .66$), which was just a little stronger than that of ACT English subtest (M_1) ($r = .65$), followed by that of ACT Mathematics subtest (M_2) ($r = .48$). Since these three variables were interrelated that one which was first selected used much of the power of the second, and thereby relegated the second factor to a position of comparatively much less value in the total regression equation than it enjoyed independently. Thus, in this case, the factor of High school grade point average (D) emerged as the "best single predictor," though this title was largely of technical rather than practical significance.

The prediction of grade point averages. The six groups studied here include: (1) Male students of the Class of 1961; (2) Female students of the Class of 1961; (3) Male students of the Class of 1962; (4) Female students of the Class of 1962; (5) Two-year male students of the Class of 1961; and (6) Two-year female students of the Class of 1961.

Male Students: Class of 1961, First Year

All eleven of the predictor variables used in the study were significant at the .01 level, with an R of .656. However, three of the variables yielded almost as high a predictive value as all eleven of the variables.

$$X_1 = .00500D + .02771M_1 + .02858M_3 - .33212$$

These were in order of their contribution to the coefficient of multiple correlation, High school grade point average (D), ACT English subtest (M_1), and ACT Social Studies subtest (M_3). These three in combination, yielded an R of .637 as compared with .656 using all eleven variables (See Appendix A, Table 22).

Best of the predictors was the factor of High school grade point average (D), displaying an R of .554 with the criterion. This was not unexpected since high school performance is generally regarded as a good prognosticator of achievement in college.

Second in order was the variable, ACT Social Studies subtest (M_3) which increased the R to .622.

The third or final predictor variable contributing to the coefficient of multiple correlation was the ACT English subtest (M_1), which brought the R to .637.

With the entry of the last mentioned variable the R had reached the level where further entries had little additional value.

Female Students: Class of 1961, First Year

Three of the eleven variables formed the best combination (.775) for predicting the first-year grade point average for female students at Middle Tennessee State College. The use of all eleven variables yielded an R of .805.

First, in terms of its zero-order coefficient of correlation with the criterion ($r = .655$), was High school grade point average (D). This r was the highest obtained between any of the predictor variables and the criterion. The presence of this factor as the first entry seemed to be in accord with the findings of many researchers that general high school achievement is a strong indicator of college performance for women.

Other variables contributing to the regression equation, shown below, were ACT English subtest (M_1) and ACT Mathematics subtest (M_2).

$$X_1 = .00470D + .05068M_1 + .02114M_2 + .31892$$

As in the previous group the variable ACT English subtest (M_1) increased the value of R by .10 more than any other variable (See

Appendix A, Table 23). The final increase of significant value in R (to .775) was made by the addition of ACT English subtest (M_2). This R of .775, with a total of 60 per cent (R^2) of the criterion variance accounted for indicated that the regression equation for female students in their first year at Middle Tennessee State College was a substantial predictor tool.

Male Students: Class of 1962, First Year

This was the only group under consideration in this study in which all eleven predictor variables did not enter the regression equation at the 1 per cent level of significance. The variable which did not enter the regression equation was the Otis Self-Administering Tests of Mental Ability (M_6). The remaining ten variables were, in order of their entry, High school grade point average (D), ACT Natural Sciences subtest (M_4), Father's educational level (G), Size of home community (E), Number of siblings (H), ACT Social Studies subtest (M_3), ACT Mathematics subtest (M_2), Father's primary occupation (F), Size of high school (C), and ACT English subtest (M_1) with an R of .504.

Two of the eleven predictor variables emerged as the most efficient combination for the prediction of first-year grade point average for male students of the Class of 1962 (Appendix A, Table 24). These were, again first, High school grade point average (D) contributing .428 to R, and ACT Natural Sciences subtest (M_4) adding .049 to R with a resultant R of .477. The regression equation was:

$$X_2 = .00524D + .02986M_4 - .12098$$

The 1961 male group had an R of .637. This was .160 greater than that of the 1962 male group. The largest single predictor variable in both male groups was that of the High school grade point average (D). In this group a predictor variable appeared which had not entered into any of the regression equations of the previous groups, namely, ACT Natural Sciences subtest (M_4) while other variables used had disappeared. One other item of note was the early appearance of non-intellectual factors in the overall equation. The next three highest variables were Father's educational level (G), Size of home community (E), and Number of siblings (H).

Female Students: Class of 1962, First Year

Three of the eleven predictor variables formed the most efficient combination, although all eleven were significant, for the prediction of college grade point average for female students of the Class of 1962. The R of this combined predictor arrayed with the criterion was quite high, being .719. Fifty-two per cent of the criterion variance was accounted for by this combination.

From Appendix A, Table 25, it may be seen that the three predictors included High school grade point average (D), Size of home community (E), and the Otis Self-Administering Tests of Mental Ability (M_6).

The regression equation was

$$X_2 = .00744D + .07190E + .02146M_6 - 1.16106$$

As in the previous groups High school grade point average (D) occupied the first position in the equation by virtue of its highest relationship to the criterion ($r = .61$).

Unlike the female group of the Class of 1961 the ACT subtests did not enter into the regression equation. Here, for the only instance in female groups, a nonintellectual predictor variable Size of home community (E) entered into consideration as did another factor for the first time, namely, the Otis Self-Administering Tests of Mental Ability (M_6).

Male Students, Two-Year Cumulative: Class of 1961

Three of the eleven predictor variables contributed to the prediction of college grade point average for second-year male students of the Class of 1961. These included, in order of their entry into the regression equation, High school grade point average (D), ACT Social Studies subtest (M_3), and Number of siblings (H) (Appendix A, Table 26). Combined, this yielded an R of .613 with the criterion.

It was worthwhile to note that this derived combination differed from the one earlier described for the prediction of first-year grade point average for the same male student group. High school grade point average (D) did appear again as the number one predictor variable ($R = .448$). In the examination of the ACT and its subtests in relationship to their respective subject matter grade point averages, the ACT Social Studies subtest (M_3) reflected a high correlation; it was thus not surprising that it would add to R in the regression equation. This was the only equation, of the sex, in which the factor, Number of siblings (H) appeared and it contributed to the predictor as a suppressor variable. Given below is the score form of the regression equation, excerpted from Appendix A, Table 26:

$$Y = .00261D + .02163M_3 - .05519H + 1.32951$$

Female Students, Two-Year Cumulative: Class of 1961

The most efficient predictor combination for this group utilized three predictor variables of the eleven studied. The three predictors included ACT Mathematics subtest (M_2), High school grade point average (D), and ACT Social Studies subtest (M_3), which yielded a coefficient of multiple correlation (R) with the criterion of .711 (Appendix A, Table 27).

ACT Mathematics subtest (M_2) appeared as the strongest single predictor, its R with the criterion being .553. The second and third entries in the regression equation for the prediction of cumulative college grade point average for two-year females of the Class of 1961 were made up of High school grade point average (D) and ACT Social Studies subtest (M_3), respectively. The former raised the R to .661 while the latter further increased it to .711.

The score weights were as follows:

$$Y = .02388M_2 + .00288D + .02378M_3 + .84400$$

Overview

Having separately presented and discussed the derived prediction regression equations for the six groups studied, it now becomes important to view them comparatively in order to appreciate their similarities and differences. Specifically one would be interested in the question of whether the regression equations, in terms of the nature and weights of their component parts, differed according to class and the sex of the groups.

In order to make comparison easier the score weights for the predictor variables forming the regression equations for the six groups have been taken from Appendix A, Tables 22 - 27, and reproduced in Table 20.

It may be seen from Table 20 that differences appeared among the predictor combinations--in the kinds of variables comprising the prediction equations, in the values (weights) these variables were given in their respective equations, and in the predictive accuracy of the equations as shown by their respective R's.

One of the assumptions made in this study was that prediction of college grade point averages would be influenced by the sex factor. Did the evidence support this assumption?

A comparison of the first year for the Class of 1961, shown in Table 20, Columns I and II revealed that only two of the eleven predictor variables were present in both the male and female equations. These were High school grade point average (D) and ACT English subtest

TABLE 20

SCORE VALUES OF ELEVEN PREDICTOR VARIABLES FOR MIDDLE TENNESSEE STATE COLLEGE GRADE POINT AVERAGE PREDICTION ACCORDING TO CRITERION

Columns	I	II	III	IV	V	VI
	X	X	X_2	X_2	Y	Y
Predictor Variable	Males 1st Year 1961	Females 1st Year 1961	Males 1st Year 1962	Females 1st Year 1962	Males Two Years 1961	Females Two Years 1961
C - High school size						
D - High school GPA	.00500	.00470	.00524	.00744	.00261	.00288
E - Size of home community				.07190		
F - Father's prim. occup.						
G - Father's eda'l level						
H - Number of siblings					-.05519	
M_1 - ACT English score	.02771	.05068				
M_2 - ACT Mathematics score		.02114				.02388
M_3 - ACT Soc. Studies score	.02858				.02162	.02378
M_4 - ACT Nat. Sciences score			.02986			
M_6 - Otis S.A.M.A. score				.02146		
Plus Constant	-.33212	-.31892	-.12098	-1.16106	1.32951	.84400
R	.637	.775	.477	.719	.613	.711
S.E. Estimate	.60	.44	.74	.56	.35	.32

(M_1). In the case of the former, its score weight was .00500 for males and .00470 for females, practically the same. The latter variable displayed a much greater difference, .02771 for the males and .05068 for females.

In the prediction of college grade point average for the first year of the Class of 1962 even larger differences existed. In Table 20, Columns III and IV it can be seen that only one of the eleven predictor variables was present in the male and female equations. This variable, High school grade point average (D), was .00524 for males and .00744 for females--a fairly large difference. However the regression equation for females used three independent variables and the regression equation for males, two variables.

The cumulative two-year grade point averages of the Class of 1961 found in Columns V and VI, of Table 20, revealed that two of the eleven predictor variables were present in the equations. These were High school grade point average (D), .00261, and ACT Social Studies subtest (M_3), .02162 for the males and .02378 for the females, relatively little difference in either of these variables. However, the third variable of the equation was quite different. For the males this was one of the two appearances of a nonintellective variable, Number of siblings (H) with a weight of -.05519, a suppressor variable. This is the only suppressor variable found in any of the equations used. The third variable for the females was ACT Mathematics subtest (M_2) with a score weight of .02388.

Notable also was the difference in predictive accuracy of the equations, with the R for each of the three female groups being significantly higher than the R for each of the respective male groups. Attempts were made to apply one sexes' prediction to the opposite sex group, for a number of students, and resulted in meaningless predictions, as might be expected in view of the respective equations. Thus it was concluded that the prediction of college grade point average should take into account the factor of sex.

The assumption that the prediction equations were different according to class was not so convincing in fact as was that of differences according to sex. In comparing Column I (Males: 1961) with Column III (Males: 1962) of Table 20 it was seen that the equations for these two groups included only one predictor variable in common, that of High school grade point average (D), which also had approximately the same score weight, .00500 and .00524 respectively.

It was also seen that the prediction equation for males of the Class of 1961 (Column I) contained two variables not included in the first-year grade point average equation for males of the Class of 1962 (Column III), these were ACT English score (M_1) and ACT Social Studies score (M_3). Conversely, the males of the Class of 1962 had in their prediction equation the variable of ACT Natural Sciences subtest (M_4)--not found in the equation for males of the Class of 1961. However, if one were to experiment, as the writer did, in applying the prediction equation of each class group to the other, the resultant predicted grade point averages were not so far out of line as one might expect with respect to the criterion. Why was this true when the same procedure did reveal appreciable differences in the sexes?

First of all, as noted above, one variable in common with both classes (High school grade point average--D) was equal in score weight. Reference to Tables 12 and 14 indicated that the coefficients of correlation for each of the ACT subtests with the criterion were about the same. Perhaps then, the ACT Natural Sciences subtest (M_4), which appeared exclusively in the equation for the male group of 1962, cancelled out the same factors as did the two subtests used in the male group of 1962 and measured roughly the same factors of academic performance.

It was also noted that the male group of the Class of 1962 (Table 20) had a much lower R (.477) than did any of the other criteria employed in this study. Perhaps this could be accounted for and, in turn, accounted for the little difference in predicted grade point average with the use of either prediction equation, because of the lack of any "A" grade students in the 1962 group. Of the N of 160 in this group, only 9 had a grade point average of "B" (3.00 - 3.99) and of these, 4 were either 3.00 or 3.02. Perhaps this partially accounted for the likeness of the prediction of the grade point averages regardless of the prediction equation employed. It should be noted that the prediction equation for the male group of the Class of 1961 was better for this procedure than was the prediction equation for the male group of the Class of 1962.

The assumption that the best combinations of variables for the prediction of college grade point average varied according to class seemed to be true insofar as the predictive variables that made up the equation were concerned and also as to their score value. However, as far as males are concerned, the actual prediction of grade point average from a practical administrative point of view this would not be as true.

The assumption that the prediction equations were different according to class for females was not so convincing as was that of the difference according to sex. In comparing Column II (Females: 1961) with Column IV (Females: 1962) of Table 20, it was seen that the equations for these two groups included only one predictor variable in common, that of High school grade point average (D) which had a significant difference in score value, .00274.

It was also seen that the prediction equation for females of the Class of 1961 (Column II) contained two variables not included in the first-year grade point average prediction equation for females of the Class of 1962 (Column IV), these were ACT English score (M_1) and ACT Mathematics score (M_2). Conversely, the females of the Class of 1962 had in their prediction equation the variables of Size of home community (E) and the Otis Self-Administering Tests of Mental Ability (M_6). This was the only first-year group in which either of these variables appeared. Nonintellectual variables appeared only twice in all the groups, once as a suppressor variable and then here as a positive variable. Here, too, the prediction equations were applied to each class group and, again, there was little difference in the ability of either prediction equation to predict the grade point average. In most cases the predictive ability was about equal. When there was a difference, the prediction equation for the female Class of 1961 was always nearer the actual grade point average than was the prediction equation for the Class of 1962.

For the women it was not as easy to give the probable reasons for this occurrence. The one variable in common was nothing like as equal in value as was the case with the male groups. Two of the ACT subtests, ACT English (M_1) and ACT Mathematics (M_2) appeared in the equation for the females of the Class of 1961 while none of the ACT subtests appeared in the prediction equation for the Class of 1962. Reference to Table 13 and 14 indicated that the coefficients of correlation for the ACT subtests and the Otis Self-Administering Tests of Mental Ability (M_6) were about the same. Perhaps the Otis accounted for a number of the same factors as the ACT subtests and, therefore, cancelled them out.

It might be appropriate, by way of bringing this part of the discussion to a close, to list those variables which did not emerge in any of the six prediction equations. There were three such variables: Size of high school (C), Father's primary occupation (F), and Father's educational level (G). It should be pointed out that all three were nonintellectual variables.

After a perusal of Appendix A, as a matter of interest, Table 21 was constructed on the basis of using four variables in each of the prediction equations. An examination of this table revealed only one variable (Size of high school--C) which was not used in at least one prediction equation. An increase in the use of non-intellectual factors was also noted, in fact, one-third of the total predictor variables were of this type. This seemed to indicate the need for further investigation into the use of nonintellectual variables as predictors of college success. There was also an increase in the use of the ACT subtests with the ACT Social Studies subtest (M_3) now appearing in four of the six prediction equations. This seemed to indicate, along with the results from the correlations of ACT subtests with their respective subject matter grade point averages (Tables 18 and 19), that the ACT Social Studies subtest (M_5) was probably the best test in the battery for predictive purposes. Without question the best predictor variable was that of High school grade point average (D) which appeared in every one of the prediction equations.

The Significance of Differences Between the Means

The numbers of cases, means, and standard deviations were obtained for each of the four groups of students used in the study. A t-test was run with three of the four groups. The female group of the Class of 1962 had only 3 dropouts out of the total sample of 130,

TABLE 21

SCORE VALUES OF ELEVEN PREDICTOR VARIABLES FOR MIDDLE TENNESSEE STATE COLLEGE GRADE POINT AVERAGE PREDICTION ACCORDING TO CRITERION

Columns	I	II	III	IV	V	VI
	X	X	X_2	X_2	Y	Y
Predictor Variable	Males 1st Year 1961	Females 1st Year 1961	Males 1st Year 1962	Females 1st Year 1962	Males Two Years 1961	Females Two Years 1961
C - High school size						
D - High school GPA	.00551	.00460	.00595	.00804	.00253	.00335
E - Size of home community	.03230		.03018	.08128		
F - Father's prim. occup.						.02827
G - Father's eda'l level			.04836		.05877	
H - Number of siblings					-.05379	
M_1 - ACT English score	.02571	.03882				
M_2 - ACT Mathematics score		.01655		-.01322		.02480
M_3 - ACT Soc. Studies score	.02643	.02106			.01897	.02238
M_4 - ACT Nat. Sciences score			.02792			
M_6 - Otis S.A.M.A. score				.01847		
Plus Constant	-.50186	-.36938	-.52415	-1.00367	1.21431	.56442
R	.644	.785	.496	.740	.638	.724
S.E. Estimate	.60	.44	.74	.55	.35	.32

and it was assumed that this would not affect the zero-order correlations to any significant extent as the scores of these 3 students on the intellectual variables were around the average.

The results of the computation of the t-tests for the remaining three groups were summarized in Appendix B, Tables 28 - 30.

A difference was considered to be significant if the probability was less than 1 in 100 that a difference as large or larger could occur by chance. In other words, the hypothesis that no real difference exists between dropouts and those remaining in college was rejected at the 1 per cent level of confidence.

From the results shown in Appendix B, Tables 28 - 30, it was concluded that the differences between the means for these two samples (dropouts and those remaining in college) in all three groups for the intellectual variables: High school grade point average (D), ACT English subtest (M_1), ACT Mathematics subtest (M_2), ACT Social Studies subtest (M_3), ACT Natural Sciences subtest (M_4), and the Otis Self-Administering Tests of Mental Ability (M_6) were less than, at the 1 per cent level of confidence, the differences which might have been obtained for any such sub-sample similarly drawn from the parent population.

A more practical conclusion would be that there was insufficient evidence of any difference between dropouts and those students remaining in college in intellectual variables, at least in the kind of population sampled.

Implications of Findings

Viewing the data from the point of overall perspective, there are a number of items worth recalling which seemed to have implication for Middle Tennessee State College and possibly for other institutions similar in student population, curricular design and grading standards.

1. The differential natures of the derived prediction equations for men as compared with women pointed decidedly to the need to treat the sexes differently in the matter of college grade point prediction. It has sometimes been argued that regardless of sex the requirements for, and standards of, college academic success remained the same and that, therefore, both sexes need the same capacities and attributes to succeed therein. This may well be true, but it does not necessarily mean that those capacities and attributes will be expressed in the same way on the high school record, in nonintellectual factors, or on entrance tests. This writer found, in most cases where a common criterion permitted comparison of the sexes, that there were marked sex differences in the nature and weights of those variables which contributed to college grade point average prediction.

It might also be pointed out that insofar as efficiency of grade point average prediction was concerned, female students were more predictable than their male counterparts. All of the coefficients of multiple correlations were higher for females than for males in like groups.

Combining the sexes for purposes of grade point prediction, in this study, caused a dilution of the data which tended to produce lesser efficiency than was obtainable by differentiating the sexes. Separate regression equations were therefore called for.

2. It was evident from the findings that three of the non-intellectual variables did not contribute to grade point average prediction in at least one of the six criteria studied, but all others did appear once or more as a predictor. It was also evident that certain of the variables appeared much more frequently than others. Notable among these was the variable of High school grade point average (D), which had a function in all six of the prediction equations evolved. The ACT Social Studies subtest (M_3) scores appeared in three of the six equations, while ACT English (M_1) and ACT Mathematics (M_2) subtests each appeared in two. Size of home community (E), Number of siblings (H), ACT Natural Sciences subtest (M_4), and the Otis Self-Administering Tests of Mental Ability (M_6) each appeared in only one prediction equation. Noteworthy here was the result that not only did the variables differ widely in absolute value in the various equations, but also in algebraic value as well, acting in some cases as negative (suppressor) variables.

3. In this study one was led to believe that the high school transcript, if viewed differentially, revealed a great deal about the candidate's academic potentialities. This, along with a reasonably good scholastic aptitude test could be all that was necessary to make efficient academic success predictions, thus rendering superfluous

the many and varied complex testing programs which had been promoted as "aids" to admissions screening. In this regard, one wondered if the presently used Otis Self-Administering Tests of Mental Ability added anything to the test battery now used at Middle Tennessee State College.

4. Another implication forthcoming from the results of this study was that of the value of the findings for guidance and counseling purposes. The application of the results of this study as post-admissions tools could be easily accomplished.

It is known that many students who entered college with ostensibly clear educational goals wished to alter their programs during the succeeding years. Further, many students embarked upon a college career admittedly without a specific objective but with the intent to decide upon an appropriate educational program after some course experience. In these types of problems it might be of some assistance in decision making to have the kinds of information provided in this study.

5. As pointed out previously another implication coming from this study was the need for further investigation into the use of nonintellectual variables as predictors of college academic success. Many investigators have urged more study of these nonintellectual factors as predictors of academic success but little research has actually been conducted in this area.

6. The application of electronic data-processing equipment to the solution of educational problems was a significant step toward utilizing available data. Lengthy statistical techniques, of value in studying human factors, were devised in the past, but using them was a laborious process which demanded more time, training, and money than most educational institutions could afford. As electronic tabulators and computers become available to educational institutions, it is probable that research such as this study will assume a much more prominent and continuing role in the development of sound guidance programs.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

This chapter presents a summarization of the study, a set of conclusions of both local and general interest, and a number of recommendations.

Purpose of the study. The purpose of this study was:

1. To determine the predictive value of a battery of tests, several nonintellectual factors, and high school achievement for college success and placement as measured by the grade point average of the students used in the study. These predictor variables included:

Variable	Code
Size of high school	C
High school grade point average	D
Size of student's home community	E
Father's primary occupation	F
Father's educational level	G
Number of siblings	H
ACT English subtest	M_1
ACT Mathematics subtest	M_2
ACT Social Studies subtest	M_3
ACT Natural Sciences subtest	M_4
Otis Self-Administering Tests of Mental Ability	M_6

2. To choose from among the variables a small set for each criterion which yielded a good prediction of college academic success and from which selection of majors was facilitated.

Procedure. The population used for the study consisted of a random sample of the Middle Tennessee State College entering freshmen classes of 1961 and 1962, for whom all eleven predictor variables were available. This group numbered 528 students, of whom 58 per cent were males and 42 per cent were females.

The study group was separated according to sex and class and provided the following six groups:

Entire male random sample for 1961
Entire female random sample for 1961
Entire male random sample for 1962
Entire female random sample for 1962
Cumulative two-year average of all males who completed two years of the Class of 1961
Cumulative two-year average of all females who completed two years of the Class of 1961

For each of the six groups, coefficients of correlation were derived among the predictor variables and between these predictors and the criteria. For the ACT composite score and each of the ACT subtests, coefficients of correlation were determined among the tests and between these tests and their respective subject matter grade point averages. Means and standard deviations of each of the variables and the criteria were calculated.

The IBM Fortran BSL-070 Stepwise Multiple Regression Program was used in order to identify, for each criterion group, that combination of predictor variables which predicted the criterion with the highest precision of which the total list was capable.

Conclusions

Major conclusion. The findings did not support the hypothesis given at the outset of the study. This hypothesis stated, there was no correlation between the separate standard scores attained by the freshmen classes of 1961 and 1962 on the Middle Tennessee State College test battery or between any of the other variables and the grade point averages achieved by these individuals during their lower division college careers. This hypothesis was rejected since it was found that in at least half the cases the amount of influence attributable to the predictive variables exceeded 50 per cent. It appeared that attempts to predict college grade point averages were warranted.

Specific conclusions. Several conclusions followed from the nature of the groups studied. These conclusions should not be considered as necessarily applicable to colleges other than Middle Tennessee State College. Significance was established at the 1 per cent level of confidence.

1. A number of the eleven predictor variables made very small contributions and satisfactory results were obtained using fewer than the total number. Results indicated that the best individual predictor in the study for either male or female was High school grade point average.

2. Those with the least value were Father's primary occupation, Size of high school, and Father's educational level, none of which was used at all in the regression equations.

3. The eleven predictor variables used are given below in order of the number of times they appeared in the six predictive equations. These numbers appear in parentheses after the names of the variables. These predictors were:

High school grade point average (6)
ACT Social Studies subtest (3)
ACT English subtest (2)
ACT Mathematics subtest (2)
Size of home community (1)
Number of siblings (1)
ACT Natural Sciences subtest (1)
Otis Self-Administering Tests of Mental Ability (1)

4. Differences among classes were not of major significance.

5. Major differences existed according to sex at Middle Tennessee State College.

6. There was insufficient evidence of any significant differences between the means of dropouts and those students remaining in college in intellectual variables.

7. The predictive equations and their related statistics should help academic counselors to make more objective predictions of individual student achievement in lower division college courses.

Recommendations

General recommendations. In addition to the aforementioned findings, the study seemed to justify certain general recommendations for college placement and selection policy.

1. It seemed that more significance should be given to the high school grades of applicants to the College. The study reaffirmed

the conclusion, often found, that good grades in high school were the best single indicator of good grades in college.

2. For placement and selection purposes, the use of the ACT subtests seemed to be amply justified as the scores on these tests were reasonably good predictors of college grade point average. However, it is doubtful that the use of the Otis Self-Administering Tests of Mental Ability could be justified administratively or financially as a predictor in combination with the ACT as it was superfluous. The use of a combination of the ACT subtests, and a major emphasis on high school grades, was practical for the College to use.

The following equations were recommended for predicting success at Middle Tennessee State College:

Males: $X = .00500D + .02771M_1 + .02858M_3 - .33212$

Females: $X = .00470D + .05068M_1 + .02114M_2 - .31892$

Recommendations for further research. As the study proceeded there came to mind a number of questions which, though not properly a part of this study, seemed provocative enough to be mentioned here as possible topics for other research.

1. Prediction equations maintain their efficiency only as long as the conditions under which the equations were derived continue. Using such equations for selection and placement inevitably alters these conditions by effecting a curtailment in the range of talent of incoming groups, thus prediction accuracy decreases. Therefore, close

check should be kept upon the groups entering subsequent to the initiation of the equations as prediction instruments. When it becomes apparent that these equations are losing their power, recalculation of the equations, based upon latest entrants, should be made.

2. There seemed to be differences in both the social and economic conditions in the area generally served by Middle Tennessee State College. These factors may influence the choice of careers, the choice of courses, and academic success. Therefore, study of the influence of these and other nonintellectual factors should be further investigated.

3. Experiments should be conducted to determine which standardized tests best evaluate achievement and predict success. Modififactions may be made in the testing program which will simultaneously increase both economy and efficiency.

4. A centralized department of research should be made a fundamental part of the College. This department should have access to data-processing and computer equipment, clerical help, and storage areas as needed.

5. It might prove worthwhile to test the value of the derived predictor equations at other colleges, to determine whether they have usefulness beyond Middle Tennessee State College.

6. Finally, there was the question, not considered in this study, of the possibility that the predictor variables studied might have differential values for college achievement prediction according to the high school from which the student came.

By way of a final summary, the one primary conclusion of the study was:

The high school grade point average is highly predictive of college grade point average, but other variables--mostly academic but also including certain nonintellectual factors--served somewhat to improve the prediction of college success.

APPENDIX A

Stepwise Multiple Regression Program Listing F Level for Each Variable Entering Step-by-Step With Its Partial Regression Coefficient, Standard Error of the Partial Coefficient, Standard Error of Dependent Variable, Constant, and the Multiple Correlation Coefficient

TABLE 22

FIRST-YEAR 1961 MALE

```
STEP NO. 1

        VARIABLE ENTERING  D
        F LEVEL  62.4523
        STANDARD ERROR OF Y  0.6460
        MULTIPLE CORRELATION COEFFICIENT  0.55404
        CONSTANT  0.26521
              VARIABLE COEFFICIENT           STD ERROR OF COEF
                X-  D     0.00635                 0.00080

STEP NO. 2

        VARIABLE ENTERING  M3
        F LEVEL  18.1642
        STANDARD ERROR OF Y  0.6099
        MULTIPLE CORRELATION COEFFICIENT  0.62173
        CONSTANT  -0.17369
              VARIABLE COEFFICIENT           STD ERROR OF COEF
                X-  D     0.00544                 0.00079
                X-  M3    0.03844                 0.00902

STEP NO. 3

        VARIABLE ENTERING  M1
        F LEVEL  4.5376
        STANDARD ERROR OF Y  0.6024
        MULTIPLE CORRELATION COEFFICIENT  0.63714
        CONSTANT  -0.33212
              VARIABLE COEFFICIENT           STD ERROR OF COEF
                X-  D     0.00500                 0.00080
                X-  M1    0.02771                 0.01301
                X-  M3    0.02858                 0.01004

STEP NO. 4

        VARIABLE ENTERING  E
        F LEVEL  2.0494
        STANDARD ERROR OF Y  0.6001
        MULTIPLE CORRELATION COEFFICIENT  0.64393
        CONSTANT  -0.50186
              VARIABLE COEFFICIENT           STD ERROR OF COEF
                X-  D     0.00551                 0.00088
                X-  E     0.03230                 0.02256
                X-  M1    0.02571                 0.01303
                X-  M3    0.02643                 0.01011
```

TABLE 22 (Continued)

```
STEP NO. 5

        VARIABLE ENTERING  M4
        F LEVEL  1.6419
        STANDARD ERROR OF Y  0.5987
        MULTIPLE CORRELATION COEFFICIENT  0.64929
        CONSTANT  -0.51626
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  D    0.00536                 0.00088
                X-  E    0.03462                 0.02258
                X-  M1   0.02116                 0.01348
                X-  M3   0.02080                 0.01101
                X-  M4   0.01172                 0.00915

STEP NO. 6

        VARIABLE ENTERING  C
        F LEVEL  0.8500
        STANDARD ERROR OF Y  0.5990
        MULTIPLE CORRELATION COEFFICIENT  0.65205
        CONSTANT  -0.62559
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  C    0.02101                 0.02279
                X-  D    0.00559                 0.00091
                X-  E    0.02895                 0.02342
                X-  M1   0.02101                 0.01349
                X-  M3   0.01949                 0.01110
                X-  M4   0.01095                 0.00919

STEP NO. 7

        VARIABLE ENTERING  G
        F LEVEL  0.4393
        STANDARD ERROR OF Y  0.6003
        MULTIPLE CORRELATION COEFFICIENT  0.65347
        CONSTANT  -0.59032
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  C    0.02390                 0.02325
                X-  D    0.00562                 0.00092
                X-  E    0.03071                 0.02362
                X-  G   -0.02576                 0.03887
                X-  M1   0.02141                 0.01353
                X-  M3   0.02068                 0.01127
                X-  M4   0.01035                 0.00925
```

TABLE 22 (Continued)

```
STEP NO. 8

         VARIABLE ENTERING  M6
         F LEVEL  0.3258
         STANDARD ERROR OF Y  0.6018
         MULTIPLE CORRELATION COEFFICIENT  0.65454
         CONSTANT  -0.69474
               VARIABLE COEFFICIENT          STD ERROR OF COEF
                 X-  C     0.02367                0.02331
                 X-  D     0.00564                0.00092
                 X-  E     0.03123                0.02370
                 X-  G    -0.02666                0.03900
                 X-  M1    0.01886                0.01428
                 X-  M3    0.01907                0.01164
                 X-  M4    0.00873                0.00970
                 X-  M6    0.00397                0.00695

STEP NO. 9

         VARIABLE ENTERING  H
         F LEVEL  0.3165
         STANDARD ERROR OF Y  0.6033
         MULTIPLE CORRELATION COEFFICIENT  0.65557
         CONSTANT  -0.77739
               VARIABLE COEFFICIENT          STD ERROR OF COEF
                 X-  C     0.02348                0.02337
                 X-  D     0.00564                0.00092
                 X-  E     0.03065                0.02378
                 X-  G    -0.02717                0.03911
                 X-  H     0.01873                0.03329
                 X-  M1    0.01926                0.01434
                 X-  M3    0.01900                0.01167
                 X-  M4    0.00849                0.00973
                 X-  M6    0.00461                0.00706

STEP NO. 10

         VARIABLE ENTERING F
         F LEVEL  0.0457
         STANDARD ERROR OF Y  0.6055
         MULTIPLE CORRELATION COEFFICIENT  0.65572
         CONSTANT  -0.77081
               VARIABLE COEFFICIENT          STD ERROR OF COEF
                 X-  C     0.02353                0.02346
                 X-  D     0.00566                0.00093
                 X-  E     0.03014                0.02399
                 X-  F    -0.00551                0.02577
```

TABLE 22 (Continued)

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- G	-0.02376	0.04237
X- H	0.01945	0.03358
X- M_1	0.01926	0.01439
X- M_3	0.01906	0.01172
X- M_4	0.00833	0.00980
X- M_6	0.00464	0.00709

STEP NO. 11

VARIABLE ENTERING M_2
F LEVEL 0.0068
STANDARD ERROR OF Y 0.6078
MULTIPLE CORRELATION COEFFICIENT 0.65575
CONSTANT -0.76585

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- C	0.02321	0.02387
X- D	0.00564	0.00099
X- E	0.03015	0.02408
X- F	-0.00579	0.02609
X- G	-0.02329	0.04291
X- H	0.01944	0.03371
X- M_1	0.01922	0.01445
X- M_2	0.00095	0.01155
X- M_3	0.01897	0.01181
X- M_4	0.00829	0.00985
X- M_6	0.00444	0.00754

TABLE 23

FIRST-YEAR 1961 FEMALE

STEP NO. 1

VARIABLE ENTERING D
F LEVEL 72.9381
STANDARD ERROR OF Y 0.5235
MULTIPLE CORRELATION COEFFICIENT 0.65514
CONSTANT 0.18835

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- D	0.00724	0.00085

STEP NO. 2

VARIABLE ENTERING M_1
F LEVEL 31.2632
STANDARD ERROR OF Y 0.4570
MULTIPLE CORRELATION COEFFICIENT 0.75460
CONSTANT -0.27866

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- D	0.00490	0.00085
X- M_1	0.06247	0.01117

STEP NO. 3

VARIABLE ENTERING M_2
F LEVEL 7.5578
STANDARD ERROR OF Y 0.4422
MULTIPLE CORRELATION COEFFICIENT 0.77534
CONSTANT -0.31892

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- D	0.00470	0.00083
X- M_1	0.05068	0.01163
X- M_2	0.02114	0.00769

STEP NO. 4

VARIABLE ENTERING M_3
F LEVEL 3.8204
STANDARD ERROR OF Y 0.4358
MULTIPLE CORRELATION COEFFICIENT 0.78532
CONSTANT -0.36938

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- D	0.00460	0.00082
X- M_1	0.03882	0.01297
X- M_2	0.01655	0.00794
X- M_3	0.02106	0.01078

TABLE 23 (Continued)

```
STEP NO. 5

         VARIABLE ENTERING  M4
         F LEVEL  2.6077
         STANDARD ERROR OF Y  0.4321
         MULTIPLE CORRELATION COEFFICIENT  0.79195
         CONSTANT  -0.31803
               VARIABLE COEFFICIENT          STD ERROR OF COEF
                 X-  D     0.00448                0.00081
                 X-  M1    0.04262                0.01307
                 X-  M2    0.01961                0.00809
                 X-  M3    0.03050                0.01218
                 X-  M4   -0.01806                0.01118

STEP NO. 6

         VARIABLE ENTERING  C
         F LEVEL  1.3932
         STANDARD ERROR OF Y  0.4312
         MULTIPLE CORRELATION COEFFICIENT  0.79545
         CONSTANT  -0.48436
               VARIABLE COEFFICIENT          STD ERROR OF COEF
                 X-  C     0.01993                0.01689
                 X-  D     0.00462                0.00082
                 X-  M1    0.04296                0.01305
                 X-  M2    0.01890                0.00810
                 X-  M3    0.02954                0.01218
                 X-  M4   -0.01579                0.01133

STEP NO. 7

         VARIABLE ENTERING  G
         F LEVEL  1.0041
         STANDARD ERROR OF Y  0.4312
         MULTIPLE CORRELATION COEFFICIENT  0.79797
         CONSTANT  -0.36977
               VARIABLE COEFFICIENT          STD ERROR OF COEF
                 X-  C     0.02295                0.01715
                 X-  D     0.00439                0.00085
                 X-  G    -0.03066                0.03060
                 X-  M1    0.04443                0.01313
                 X-  M2    0.01853                0.00811
                 X-  M3    0.03096                0.01226
                 X-  M4   -0.01619                0.01133
```

TABLE 23 (Continued)

```
STEP NO. 8

        VARIABLE ENTERING  F
        F LEVEL  2.2332
        STANDARD ERROR OF Y  0.4283
        MULTIPLE CORRELATION COEFFICIENT  0.80346
        CONSTANT  -0.47366
              VARIABLE COEFFICIENT           STD ERROR OF COEF
                X-  C    0.02007                  0.01715
                X-  D    0.00444                  0.00084
                X-  F    0.03527                  0.02360
                X-  G   -0.05812                  0.03551
                X-  M1   0.04486                  0.01305
                X-  M2   0.01961                  0.00809
                X-  M3   0.02991                  0.01220
                X-  M4  -0.01539                  0.01127

STEP NO. 9

        VARIABLE ENTERING  E
        F LEVEL 0.5574
        STANDARD ERROR OF Y  0.4293
        MULTIPLE CORRELATION COEFFICIENT  0.80483
        CONSTANT  -0.58430
              VARIABLE COEFFICIENT           STD ERROR OF COEF
                X-  C    0.01442                  0.01878
                X-  D    0.00489                  0.00104
                X-  E    0.01776                  0.02379
                X-  F    0.03686                  0.02376
                X-  G   -0.05704                  0.03563
                X-  M1   0.04285                  0.01335
                X-  M2   0.01795                  0.00840
                X-  M3   0.02901                  0.01229
                X-  M4  -0.01498                  0.01131

STEP NO. 10

        VARIABLE ENTERING  H
        F LEVEL  0.2140
        STANDARD ERROR OF Y  0.4312
        MULTIPLE CORRELATION COEFFICIENT  0.80536
        CONSTANT  -0.53349
              VARIABLE COEFFICIENT           STD ERROR OF COEF
                X-  C    0.01410                  0.01888
                X-  D    0.00483                  0.00105
                X-  E    0.01472                  0.02478
                X-  F    0.03943                  0.02450
```

TABLE 23 (Continued)

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- G	-0.05872	0.03597
X- H	-0.01245	0.02691
X- M_1	0.04260	0.01342
X- M_2	0.01853	0.00853
X- M_3	0.02939	0.01237
X- M_4	-0.01536	0.01139

STEP NO. 11

VARIABLE ENTERING M_6
F LEVEL 0.0175
STANDARD ERROR OF Y 0.4337
MULTIPLE CORRELATION COEFFICIENT 0.80541
CONSTANT -0.55205

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- C	0.01368	0.01924
X- D	0.00482	0.00106
X- E	0.01460	0.02493
X- F	0.03959	0.02467
X- G	-0.05906	0.03627
X- H	-0.01223	0.02711
X- M_1	0.04220	0.01383
X- M_2	0.01822	0.00890
X- M_3	0.02902	0.01275
X- M_4	-0.01579	0.01190
X- M_6	0.00097	0.00732

TABLE 24

FIRST-YEAR 1962 MALE

```
STEP NO. 1

        VARIABLE ENTERING  D
        F LEVEL  35.4587
        STANDARD ERROR OF Y  0.7628
        MULTIPLE CORRELATION COEFFICIENT  0.42812
        CONSTANT  0.26049
              VARIABLE COEFFICIENT            STD ERROR OF COEF
                X-  D    0.00586                    0.00098

STEP NO. 2

        VARIABLE ENTERING  M4
        F LEVEL  8.9966
        STANDARD ERROR OF Y  0.7442
        MULTIPLE CORRELATION COEFFICIENT  0.47702
        CONSTANT  -0.12098
              VARIABLE COEFFICIENT            STD ERROR OF COEF
                X-  D    0.00524                    0.00098
                X-  M4   0.02986                    0.00995

STEP NO. 3

        VARIABLE ENTERING  G
        F LEVEL  2.3488
        STANDARD ERROR OF Y  0.7411
        MULTIPLE CORRELATION COEFFICIENT 0.48889
        CONSTANT  -0.33914
              VARIABLE COEFFICIENT            STD ERROR OF COEF
                X-  D    0.00546                    0.00099
                X-  G    0.05629                    0.03673
                X-  M4   0.02855                    0.00995

STEP NO. 4

        VARIABLE ENTERING  E
        F LEVEL  1.3766
        STANDARD ERROR OF Y  0.7402
        MULTIPLE CORRELATION COEFFICIENT  0.49569
        CONSTANT  -0.52415
              VARIABLE COEFFICIENT            STD ERROR OF COEF
                X-  D    0.00595                    0.00107
                X-  E    0.03018                    0.02572
                X-  G    0.04836                    0.03730
                X-  M4   0.02792                    0.00995
```

TABLE 24 (Continued)

```
STEP NO. 5

        VARIABLE ENTERING  H
        F LEVEL  1.2756
        STANDARD ERROR OF Y  0.7395
        MULTIPLE CORRELATION COEFFICIENT  0.50190
        CONSTANT  -0.70454
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  D    0.00602                0.00107
                X-  E    0.03067                0.02570
                X-  G    0.06039                0.03876
                X-  H    0.03805                0.03369
                X-  M4   0.02803                0.00994

STEP NO. 6

        VARIABLE ENTERING  M3
        F LEVEL  0.3191
        STANDARD ERROR OF Y  0.7412
        MULTIPLE CORRELATION COEFFICIENT  0.50345
        CONSTANT  -0.66412
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  D    0.00612                0.00109
                X-  E    0.03169                0.02582
                X-  G    0.05887                0.03893
                X-  H    0.03577                0.03400
                X-  M3  -0.00851                0.01506
                X-  M4   0.03295                0.01324

STEP NO. 7

        VARIABLE ENTERING  M2
        F LEVEL  0.0607
        STANDARD ERROR OF Y  0.7434
        MULTIPLE CORRELATION COEFFICIENT  0.50375
        CONSTANT  -0.66628
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  D    0.00606                0.00112
                X-  E    0.03164                0.02591
                X-  G    0.05765                0.03937
                X-  H    0.03566                0.03411
                X-  M2   0.00308                0.01251
                X-  M3  -0.00919                0.01536
                X-  M4   0.03183                0.01404
```

TABLE 24 (Continued)

```
STEP NO. 8

        VARIABLE ENTERING  F
        F LEVEL  0.0247
        STANDARD ERROR OF Y  0.7458
        MULTIPLE CORRELATION COEFFICIENT  0.50387
        CONSTANT  -0.66658
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  D     0.00605                0.00113
                X-  E     0.03172                0.02599
                X-  F     0.00477                0.03035
                X-  G     0.05466                0.04385
                X-  H     0.03477                0.03469
                X-  M2    0.00273                0.01274
                X-  M3   -0.00889                0.01552
                X-  M4    0.03148                0.01426

STEP NO. 9

        VARIABLE ENTERING  C
        F LEVEL  0.0110
        STANDARD ERROR OF Y  0.7483
        MULTIPLE CORRELATION COEFFICIENT  0.50392
        CONSTANT  -0.65156
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  C    -0.00288                0.02744
                X-  D     0.00601                0.00117
                X-  E     0.03242                0.02692
                X-  F     0.00438                0.03067
                X-  G     0.05494                0.04407
                X-  H     0.03450                0.03489
                X-  M2    0.00299                0.01301
                X-  M3   -0.00887                0.01557
                X-  M4    0.03161                0.01436

STEP NO. 10

        VARIABLE ENTERING  M1
        F LEVEL  0.0021
        STANDARD ERROR OF Y  0.7508
        MULTIPLE CORRELATION COEFFICIENT  0.50393
        CONSTANT  -0.64855
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  C    -0.00297                0.02759
                X-  D     0.00602                0.00118
                X-  E     0.03241                0.02701
                X-  F     0.00444                0.03080
```

TABLE 24 (Continued)

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- G	0.05514	0.04444
X- H	0.03443	0.03505
X- M_1	-0.00071	0.01567
X- M_2	0.00313	0.01342
X- M_3	-0.00878	0.01575
X- M_4	0.03182	0.01513

TABLE 25

FIRST-YEAR 1962 FEMALE

```
STEP NO. 1

        VARIABLE ENTERING  D
        F LEVEL  74.3122
        STANDARD ERROR OF Y  0.6343
        MULTIPLE CORRELATION COEFFICIENT  0.61215
        CONSTANT  -0.12735
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  D    0.00840                 0.00097

STEP NO. 2

        VARIABLE ENTERING  M6
        F LEVEL  24.3083
        STANDARD ERROR OF Y  0.5819
        MULTIPLE CORRELATION COEFFICIENT  0.69131
        CONSTANT -0.78782
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  D    0.00641                 0.00098
                X-  M6   0.02534                 0.00514

STEP NO. 3

        VARIABLE ENTERING  E
        F LEVEL  9.6961
        STANDARD ERROR OF Y  0.5624
        MULTIPLE CORRELATION COEFFICIENT  0.71857
        CONSTANT -1.16106
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  D    0.00744                 0.00100
                X-  E    0.07190                 0.02309
                X-  M6   0.02146                 0.00512

STEP NO. 4

        VARIABLE ENTERING  M2
        F LEVEL  8.5431
        STANDARD ERROR OF Y  0.5458
        MULTIPLE CORRELATION COEFFICIENT  0.74043
        CONSTANT  -1.00367
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  D    0.00804                 0.00100
                X-  E    0.08128                 0.02264
                X-  M2  -0.01322                 0.00452
                X-  M6   0.01847                 0.00507
```

TABLE 25 (Continued)

```
STEP NO. 5

        VARIABLE ENTERING C
        F LEVEL  6.0720
        STANDARD ERROR OF Y  0.5347
        MULTIPLE CORRELATION COEFFICIENT  0.75498
        CONSTANT -1.27873
              VARIABLE COEFFICIENT             STD ERROR OF COEF
                X-  C     0.05075                  0.02059
                X-  D     0.00885                  0.00103
                X-  E     0.06239                  0.02346
                X-  M2   -0.01662                  0.00464
                X-  M6    0.01587                  0.00508

STEP NO. 6

        VARIABLE ENTERING  G
        F LEVEL  2.7381
        STANDARD ERROR OF Y  0.5309
        MULTIPLE CORRELATION COEFFICIENT 0.76136
        CONSTANT  -1.43445
              VARIABLE COEFFICIENT             STD ERROR OF COEF
                X-  C     0.04598                  0.02065
                X-  D     0.00902                  0.00103
                X-  E     0.06592                  0.02339
                X-  G     0.04607                  0.02784
                X-  M2   -0.01625                  0.00461
                X-  M6    0.01466                  0.00510

STEP NO. 7

        VARIABLE ENTERING  M3
        F LEVEL  0.8484
        STANDARD ERROR OF Y  0.5312
        MULTIPLE CORRELATION COEFFICIENT  0.76333
        CONSTANT  -1.40314
              VARIABLE COEFFICIENT             STD ERROR OF COEF
                X-  C     0.04046                  0.02151
                X-  D     0.00871                  0.00108
                X-  E     0.06289                  0.02364
                X-  G     0.04489                  0.02789
                X-  M2   -0.02106                  0.00697
                X-  M3    0.01237                  0.01344
                X-  M6    0.01395                  0.00516
```

TABLE 25 (Continued)

STEP NO. 8

VARIABLE ENTERING F
F LEVEL 0.7612
STANDARD ERROR OF Y 0.5317
MULTIPLE CORRELATION COEFFICIENT 0.76509
CONSTANT -1.45099

VARIABLE		COEFFICIENT	STD ERROR OF COEF
X-	C	0.03807	0.02171
X-	D	0.00875	0.00108
X-	E	0.06549	0.02385
X-	F	0.02051	0.02350
X-	G	0.03190	0.03164
X-	M_2	-0.02111	0.00698
X-	M_3	0.01193	0.01346
X-	M_6	0.01387	0.00517

STEP NO. 9

VARIABLE ENTERING M_4
F LEVEL 0.3785
STANDARD ERROR OF Y 0.5332
MULTIPLE CORRELATION COEFFICIENT 0.76597
CONSTANT -1.42813

VARIABLE		COEFFICIENT	STD ERROR OF COEF
X-	C	0.03573	0.02210
X-	D	0.00865	0.00110
X-	E	0.06297	0.02426
X-	F	0.01975	0.02360
X-	G	0.03179	0.03172
X-	M_2	-0.01804	0.00859
X-	M_3	0.01879	0.01751
X-	M_4	-0.00703	0.01142
X-	M_6	0.01356	0.00520

STEP NO. 10

VARIABLE ENTERING H
F LEVEL 0.0389
STANDARD ERROR OF Y 0.5354
MULTIPLE CORRELATION COEFFICIENT 0.76606
CONSTANT -1.44538

VARIABLE		COEFFICIENT	STD ERROR OF COEF
X-	C	0.03619	0.02231
X-	D	0.00865	0.00110
X-	E	0.06320	0.02439

TABLE 25 (Continued)

```
          VARIABLE COEFFICIENT              STD ERROR OF COEF
            X-  F     0.01944                   0.02375
            X-  G     0.03147                   0.03189
            X-  H     0.00603                   0.03061
            X-  M2   -0.01780                   0.00871
            X-  M3    0.01862                   0.01760
            X-  M4   -0.00708                   0.01147
            X-  M6    0.01353                   0.00523
STEP NO. 11

       VARIABLE ENTERING  M1
       F LEVEL  0.0049
       STANDARD ERROR OF Y  0.5377
       MULTIPLE CORRELATION COEFFICIENT  0.76608
       CONSTANT  -1.44284
          VARIABLE COEFFICIENT              STD ERROR OF COEF
            X-  C     0.03629                   0.02245
            X-  D     0.00867                   0.00112
            X-  E     0.06295                   0.02475
            X-  F     0.01924                   0.02401
            X-  G     0.03180                   0.03239
            X-  H     0.00611                   0.03076
            X-  M1   -0.00118                   0.01683
            X-  M2   -0.01776                   0.00877
            X-  M3    0.01893                   0.01821
            X-  M4   -0.00723                   0.01172
            X-  M6    0.01380                   0.00646
```

TABLE 26

CUMULATIVE TWO-YEAR 1961 MALE

```
STEP NO. 1

         VARIABLE ENTERING  D
         F LEVEL  20.5713
         STANDARD ERROR OF Y  0.3834
         MULTIPLE CORRELATION COEFFICIENT  0.48747
         CONSTANT  1.38574
               VARIABLE COEFFICIENT          STD ERROR OF COEF
                 X-  D     0.00327                0.00072

STEP NO. 2

         VARIABLE ENTERING  M3
         F LEVEL  9.1371
         STANDARD ERROR OF Y  0.3617
         MULTIPLE CORRELATION COEFFICIENT  0.57583
         CONSTANT  1.10741
               VARIABLE COEFFICIENT          STD ERROR OF COEF
                 X-  D     0.00266                0.00071
                 X-  M3    0.02436                0.00806

STEP NO. 3

         VARIABLE ENTERING  H
         F LEVEL  4.5348
         STANDARD ERROR OF Y  0.3523
         MULTIPLE CORRELATION COEFFICIENT  0.61303
         CONSTANT  1.32951
               VARIABLE COEFFICIENT          STD ERROR OF COEF
                 X-  D     0.00261                0.00069
                 X-  H    -0.05519                0.02592
                 X-  M3    0.02162                0.00795

STEP NO. 4

         VARIABLE ENTERING  G
         F LEVEL  3.2733
         STANDARD ERROR OF Y  0.3462
         MULTIPLE CORRELATION COEFFICIENT  0.63768
         CONSTANT  1.21431
               VARIABLE COEFFICIENT          STD ERROR OF COEF
                 X-  D     0.00253                0.00068
                 X-  G     0.05877                0.03248
                 X-  H    -0.05379                0.02548
                 X-  M3    0.01697                0.00795
```

TABLE 26 (Continued)

```
STEP NO. 5

        VARIABLE ENTERING  M6
        F LEVEL  0.7087
        STANDARD ERROR OF Y  0.3470
        MULTIPLE CORRELATION COEFFICIENT  0.64292
        CONSTANT  1.36510
              VARIABLE COEFFICIENT            STD ERROR OF COEF
                X-  D     0.00265                  0.00070
                X-  G     0.06038                  0.03261
                X-  H    -0.06231                  0.02747
                X-  M3    0.02333                  0.00950
                X-  M6   -0.00468                  0.00556

STEP NO. 6

        VARIABLE ENTERING  F
        F LEVEL  0.7118
        STANDARD ERROR OF Y  0.3478
        MULTIPLE CORRELATION COEFFICIENT  0.64816
        CONSTANT  1.36494
              VARIABLE COEFFICIENT            STD ERROR OF COEF
                X-  D     0.00280                  0.00072
                X-  F    -0.01838                  0.02178
                X-  G     0.07361                  0.03626
                X-  H    -0.05782                  0.02804
                X-  M3    0.02356                  0.00953
                X-  M6   -0.00496                  0.00558

STEP NO. 7

        VARIABLE ENTERING  M1
        F LEVEL  0.3711
        STANDARD ERROR OF Y  0.3496
        MULTIPLE CORRELATION COEFFICIENT  0.65090
        CONSTANT  1.36321
              VARIABLE COEFFICIENT            STD ERROR OF COEF
                X-  D     0.00272                  0.00074
                X-  F    -0.01678                  0.02205
                X-  G     0.07087                  0.03672
                X-  H    -0.05925                  0.02829
                X-  M1    0.00727                  0.01194
                X-  M3    0.02211                  0.00987
                X-  M6   -0.00634                  0.00605
```

TABLE 26 (Continued)

```
STEP NO. 8

        VARIABLE ENTERING  C
        F LEVEL  0.2838
        STANDARD ERROR OF Y  0.3517
        MULTIPLE CORRELATION COEFFICIENT  0.65302
        CONSTANT  1.31557
              VARIABLE COEFFICIENT           STD ERROR OF COEF
                X-  C     0.00961                 0.01841
                X-  D     0.00283                 0.00077
                X-  F    -0.01551                 0.02231
                X-  G     0.06590                 0.03810
                X-  H    -0.06115                 0.02868
                X-  M1    0.00646                 0.01211
                X-  M3    0.02185                 0.00994
                X-  M6   -0.00632                 0.00609
STEP NO. 9

        VARIABLE ENTERING  E
        F LEVEL  0.1427
        STANDARD ERROR OF Y  0.3543
        MULTIPLE CORRELATION COEFFICIENT  0.65410
        CONSTANT  1.25869
              VARIABLE COEFFICIENT           STD ERROR OF COEF
                X-  C     0.00749                 0.01953
                X-  D     0.00297                 0.00086
                X-  E     0.00856                 0.02265
                X-  F    -0.01463                 0.02259
                X-  G     0.06236                 0.03951
                X-  H    -0.06000                 0.02905
                X-  M1    0.00651                 0.01220
                X-  M3    0.02089                 0.01033
                X-  M6   -0.00594                 0.00621
STEP NO. 10

        VARIABLE ENTERING  M4
        F LEVEL  0.1022
        STANDARD ERROR OF Y  0.3571
        MULTIPLE CORRELATION COEFFICIENT  0.65488
        CONSTANT  1.24621
              VARIABLE COEFFICIENT           STD ERROR OF COEF
                X-  C     0.00899                 0.02024
                X-  D     0.00299                 0.00087
                X-  E     0.00768                 0.02299
                X-  F    -0.01523                 0.02285
```

TABLE 26 (Continued)

```
            VARIABLE COEFFICIENT          STD ERROR OF COEF
              X-  G    0.06074               0.04014
              X-  H   -0.05970               0.02929
              X-  M1   0.00718               0.01247
              X-  M3   0.02202               0.01099
              X-  M4  -0.00249               0.00780
              X-  M6  -0.00546               0.00644

STEP NO. 11

      VARIABLE ENTERING  M2
      F LEVEL  0.0190
      STANDARD ERROR OF Y  0.3602
      MULTIPLE CORRELATION COEFFICIENT  0.65503
      CONSTANT  1.23145
            VARIABLE COEFFICIENT          STD ERROR OF COEF
              X-  C    0.00970               0.02105
              X-  D    0.00305               0.00097
              X-  E    0.00801               0.02331
              X-  F   -0.01482               0.02324
              X-  G    0.05993               0.04092
              X-  H   -0.06001               0.02963
              X-  M1   0.00707               0.01261
              X-  M2  -0.00137               0.00995
              X-  M3   0.02206               0.01109
              X-  M4  -0.00252               0.00787
              X-  M6  -0.00501               0.00725
```

TABLE 27

CUMULATIVE TWO-YEAR 1961 FEMALE

STEP NO. 1

VARIABLE ENTERING M_2
F LEVEL 25.8955
STANDARD ERROR OF Y 0.3714
MULTIPLE CORRELATION COEFFICIENT 0.55229
CONSTANT 1.98364

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- M_2	0.03695	0.00726

STEP NO. 2

VARIABLE ENTERING D
F LEVEL 13.5563
STANDARD ERROR OF Y 0.3372
MULTIPLE CORRELATION COEFFICIENT 0.66083
CONSTANT 1.10547

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- D	0.00319	0.00087
X- M_2	0.02915	0.00693

STEP NO. 3

VARIABLE ENTERING M_3
F LEVEL 7.8911
STANDARD ERROR OF Y 0.3188
MULTIPLE CORRELATION COEFFICIENT 0.71077
CONSTANT 0.84400

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- D	0.00288	0.00083
X- M_2	0.02388	0.00681
X- M_3	0.02378	0.00847

STEP NO. 4

VARIABLE ENTERING F
F LEVEL 2.2548
STANDARD ERROR OF Y 0.3153
MULTIPLE CORRELATION COEFFICIENT 0.72412
CONSTANT 0.56442

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- D	0.00335	0.00088
X- F	0.02827	0.01883
X- M_2	0.02480	0.00677
X- M_3	0.02238	0.00843

TABLE 27 (Continued)

```
STEP NO. 5

          VARIABLE ENTERING  G
          F LEVEL  1.8667
          STANDARD ERROR OF Y  0.3129
          MULTIPLE CORRELATION COEFFICIENT  0.73482
          CONSTANT  0.66776
                 VARIABLE COEFFICIENT            STD ERROR OF COEF
                   X-  D     0.00309                  0.00089
                   X-  F     0.04128                  0.02097
                   X-  G    -0.04312                  0.03156
                   X-  M2    0.02551                  0.00673
                   X-  M3    0.02501                  0.00858

STEP NO. 6

          VARIABLE ENTERING  M4
          F LEVEL  1.3583
          STANDARD ERROR OF Y  0.3119
          MULTIPLE CORRELATION COEFFICIENT  0.74246
          CONSTANT  0.67806
                 VARIABLE COEFFICIENT            STD ERROR OF COEF
                   X-  D     0.00307                  0.00089
                   X-  F     0.04472                  0.02111
                   X-  G    -0.04933                  0.03190
                   X-  M2    0.02873                  0.00726
                   X-  M3    0.03430                  0.01169
                   X-  M4   -0.01316                  0.01129

STEP NO. 7
          VARIABLE ENTERING  M6
          F LEVEL  1.5842
          STANDARD ERROR OF Y  0.3102
          MULTIPLE CORRELATION COEFFICIENT  0.75118
          CONSTANT  0.45683
                 VARIABLE COEFFICIENT            STD ERROR OF COEF
                   X-  D     0.00293                  0.00089
                   X-  F     0.04464                  0.02099
                   X-  G    -0.05172                  0.03179
                   X-  M2    0.02629                  0.00747
                   X-  M3    0.03079                  0.01196
                   X-  M4   -0.01654                  0.01155
                   X-  M6    0.00824                  0.00655
```

TABLE 27 (Continued)

```
STEP NO. 8

        VARIABLE ENTERING  C
        F LEVEL  0.8812
        STANDARD ERROR OF Y  0.3106
        MULTIPLE CORRELATION COEFFICIENT  0.75600
        CONSTANT  0.50371
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  C   -0.01712                 0.01823
                X-  D    0.00280                 0.00090
                X-  F    0.04887                 0.02150
                X-  G   -0.05065                 0.03185
                X-  M2   0.02597                 0.00749
                X-  M3   0.03160                 0.01200
                X-  M4  -0.02090                 0.01246
                X-  M6   0.01055                 0.00700

STEP NO. 9

        VARIABLE ENTERING  E
        F LEVEL  1.8090
        STANDARD ERROR OF Y  0.3082
        MULTIPLE CORRELATION COEFFICIENT  0.76564
        CONSTANT  0.25792
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  C   -0.02588                 0.01923
                X-  D    0.00349                 0.00103
                X-  E    0.02698                 0.02006
                X-  F    0.05536                 0.02187
                X-  G   -0.05027                 0.03160
                X-  M2   0.02389                 0.00759
                X-  M3   0.03030                 0.01195
                X-  M4  -0.02142                 0.01237
                X-  M6   0.01061                 0.00695

STEP NO. 10

        VARIABLE ENTERING  H
        F LEVEL  0.2912
        STANDARD ERROR OF Y  0.3104
        MULTIPLE CORRELATION COEFFICIENT  0.76721
        CONSTANT  0.29822
              VARIABLE COEFFICIENT          STD ERROR OF COEF
                X-  C   -0.02676                 0.01943
                X-  D    0.00346                 0.00104
                X-  E    0.02404                 0.02092
                X-  F    0.05895                 0.02300
```

TABLE 27 (Continued)

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- G	-0.05278	0.03216
X- H	-0.01428	0.02647
X- M_2	0.02427	0.00768
X- M_3	0.03064	0.01205
X- M_4	-0.02140	0.01246
X- M_6	0.01058	0.00700

STEP NO. 11

VARIABLE ENTERING M_1
F LEVEL 0.1555
STANDARD ERROR OF Y 0.3130
MULTIPLE CORRELATION COEFFICIENT 0.76805
CONSTANT 0.28465

VARIABLE	COEFFICIENT	STD ERROR OF COEF
X- C	-0.02634	0.01963
X- D	0.00336	0.00108
X- E	0.02279	0.02133
X- F	0.05871	0.02321
X- G	-0.05360	0.03250
X- H	-0.01468	0.02671
X- M_1	0.00500	0.01268
X- M_2	0.02403	0.00777
X- M_3	0.02990	0.01230
X- M_4	-0.02191	0.01263
X- M_6	0.01021	0.00712

APPENDIX B

Number of Cases, Means, Standard Deviations, and t-Scores for Intellectual Variables Between Dropouts and Those Students Who Remained in College

TABLE 28

1961 MALE

Variable	Group	Number of Cases	Mean	Standard Deviation	t
High school grade point average	Sample used	143	2.35	.67	.647
	Dropouts	14	2.24	.55	
ACT English subtest	Sample used	143	15.46	4.65	1.261
	Dropouts	14	13.43	5.90	
ACT Mathematics subtest	Sample used	143	16.72	5.88	.947
	Dropouts	14	18.14	5.00	
ACT Social Studies subtest	Sample used	143	16.97	5.87	1.843
	Dropouts	14	13.21	7.14	
ACT Natural Sciences subtest	Sample used	143	17.50	7.02	.420
	Dropouts	14	16.71	6.42	
Otis Self-Administering Tests of Mental Ability	Sample used	143	49.62	9.79	.392
	Dropouts	21	48.52	12.10	

TABLE 29

1962 MALE

Variable	Group	Number of Cases	Mean	Standard Deviation	t
High school grade point average	Sample used	160	2.24	.36	.670
	Dropouts	10	2.35	.49	
ACT English subtest	Sample used	160	16.10	5.05	.872
	Dropouts	10	14.40	5.74	
ACT Mathematics subtest	Sample used	160	16.91	5.98	.157
	Dropouts	10	16.40	3.26	
ACT Social Studies subtest	Sample used	160	16.55	5.40	.346
	Dropouts	10	17.00	3.60	
ACT Natural Sciences subtest	Sample used	160	17.43	6.04	.518
	Dropouts	10	18.00	3.16	
Otis Self-Administering Tests of Mental Ability	Sample used	160	49.96	10.91	1.027
	Dropouts	17	46.94	11.25	

TABLE 30

1961 FEMALE

Variable	Group	Number of Cases	Mean	Standard Deviation	t
High school grade point average	Sample used	99	3.00	.62	.200
	Dropouts	5	3.02	.65	
ACT English subtest	Sample used	99	18.74	4.72	1.233
	Dropouts	9	20.22	3.32	
ACT Mathematics subtest	Sample used	99	15.19	6.49	.100
	Dropouts	9	15.00	5.37	
ACT Social Studies subtest	Sample used	99	17.70	5.48	.583
	Dropouts	9	16.89	3.63	
ACT Natural Sciences subtest	Sample used	99	16.70	5.64	.900
	Dropouts	9	15.89	2.02	
Otis Self-Administering Tests of Mental Ability	Sample used	99	51.28	9.46	.476
	Dropouts	11	52.64	8.52	

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BIOGRAPHICAL SKETCH

Arlie Andrew Adkins was born September 17, 1923, at Easley, South Carolina. In May, 1940, he was graduated from Welcome High School. In May, 1954, he received the degree of Bachelor of Arts from Washington Bible College. In May, 1955, he received the degree of Bachelor of Theology from Piedmont Bible College. In May, 1956, he received the degree of Master of Arts from Bob Jones University. From 1956 until 1959 he served as President of Southern Methodist College. In the summer of 1958 he enrolled in the Graduate School of Appalachian State Teachers College. Here he worked as a part time instructor in the Department of Psychology and Education from September, 1959 to August, 1960. In May, 1960, he received the degree of Master of Arts from Appalachian State Teachers College. In 1960 he enrolled in the Graduate School of the University of Florida where he held a Kellogg Fellowship. From September, 1960, until the present time he has pursued his work toward the degree of Doctor of Education. Since September, 1961 to the present he has been Assistant Professor of Education at Middle Tennessee State College.

Arlie Andrew Adkins is married to the former Marjorie Anne Johnston and is the father of one child. He is a member of Phi Delta Kappa, Chi Alpha Omega, the American Educational Research Association, the Tennessee Education Association, the Middle Tennessee Personnel and Guidance Association, the Southern College Personnel Association, and the American Personnel and Guidance Association.

This dissertation was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of that committee. It was submitted to the Dean of the College of Education and to the Graduate Council, and was approved as partial fulfillment of the requirements for the degree of Doctor of Education.

December 21, 1963

J. B. White
Dean, College of Education

L. E. Grinter
Dean, Graduate School

Supervisory Committee:

R. L. Johns
Chairman

Mell H. Atchley

Ralph B. Kimbrough

S. P. Wiggins

V. A. Hines